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[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

AF Political Chief on Interethnic Relations

90UM0621A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 1-3

[Article by Lt Gen Avn G. Benov, member, military council, chief of Air Force Political Directorate: "Consolidating Leninist Ideas of Internationalism"]

[Text] The revolutionary process of perestroyka in our society, in the party, and in the Armed Forces has become irreversible. It is penetrating horizontally and vertically, encompassing all domains of our daily lives and activities. Frequently the process does not proceed smoothly and encounters conflict. Habits, notions developed over the course of decades, views, and dogmas crumble and are reanalyzed. Such a process is also presently taking place within the domain of ethnic relations and internationalist indoctrination of Soviet citizens and the armed defenders of the homeland.

Not so long ago we were proud of the fact that we had fully resolved this problem, which is inherent in many states with various societal and political system. Today such an assertion would be wrong. Yes, a great deal has been accomplished. One can state with full justification that a solid foundation has been placed under our multiethnic house. But a great deal remains to be improved. I would say that this issue is too sensitive and fragile, and at the same time important, permeating the economy, politics, culture, and ideology.

V. I. Lenin spoke time and again about the acuteness, complexity, and multifaceted nature of this problem. And today, on the eve of the 120th anniversary of his birth, we turn once again to his immortal thoughts and ideas. Take the article "On the National Pride of the Great Russians." Beginning with the words: "Today people are talking, discussing, shouting a great deal about nationality, about homeland!", it goes on to discuss the essence of patriotism, love for the homeland, nationalism, and internationalism. There is a great deal in this article to stir up our consciousness, which has been seized by the events and conflicts of the present day. V. I. Lenin's comment that "it would be unbecoming for us, members of a great-power nation in the extreme eastern part of Europe and a good part of Asia, to forget about the enormous significance of the nationalities question" sounds highly relevant to the present day.

And what about that? We may not have forgotten it, but in any case for a long time we did not bring it to mind. Is this not why in the past there have been instances of suppression of ethnic cultures and persecutions of entire peoples. Is this not why we have now encountered activation of openly anti-Soviet groups, nationalist and separatist elements which, seeking to profit from increased ethnic self-awareness by the peoples of the USSR and difficulties with socioeconomic development, are deliberately aggravating the situation and stirring up interethnic conflicts. A vivid example of this is the events in Azerbaijan and Armenia.

The party considers the present situation extremely complex as regards this issue. M. S. Gorbachev made a profound statement at the special CPSU Central Committee Plenum last December: "We must 'achieve federation' anew, by restoring mutual trust and by perceiving the advantages of integration." Yes, we must take into consideration the unique nature of each people, of each region, their individuality and at the same time their indissolubility.

This applies in full measure to work pertaining to internationalist indoctrination of Air Force personnel. It is of enormous importance, since it is directly linked to the combat readiness of combined units and units which, as we know from the requirements of our defensive military doctrine, must be at a high qualitative level. And the human factor plays a leading role here. The importance and significance of the internationalist factor were put to the test and were tempered in the crucible of the Great Patriotic War, in the skies and on the soil of Afghanistan, and in Air Force peacetime training. Nor should it be underrated in the present day.

Both national and regional problems are reflected in our Air Force units as in a drop of water. Nor could it be otherwise, for servicemen representing almost 40 nationalities serve in every combined unit, and as many as 25 nationalities in the units. They include many young men from the Baltic republics, from Transcaucasia, Moldavia and other republics in which there have frequently been instances of discrimination, infringement of the civil rights and injury to the personal dignity of military personnel and their families, where one hears open appeals to station our military forces on the basis of nationality and to form local national military units. It is no secret that some military personnel harbor such ideas, nationalist and chauvinist attitudes and pacifist views. And these attitudes and views are coming to the surface wherever they are not adequately rebuffed.

The matter of improving internationalist indoctrination of personnel and unifying multiethnic military collectives assumes exceptional importance in these conditions.

It would be erroneous to assume that we have done nothing and are doing nothing in this area. Study of the activities of military councils, political agencies, command and political personnel, party and Komsomol organizations has shown that progress has been made in this area. Mutual relations in the majority of multiethnic military units in the Air Force are healthy and stable for the most part. Efforts being made in these units are helping broaden contacts among Air Force personnel of different nationalities and are helping develop in them an internationalist consciousness and behavior. The political agencies with which comrades V. Vereshchagin, V. Filatov, V. Vasin, and others serve perform the function of initiator in this matter. At their initiative,

matters pertaining to internationalist indoctrination have moved to the center of activities of political agencies, are involved in the system of instruction-methods work with various categories of leader personnel and party activists, and are regularly raised at training sessions and seminars for political instruction group leaders. Dissemination of legal information plans and schedules have been drawn up and are being adopted, prescribing many measures aimed at strengthening military comradeship, eliminating and preventing instances of mutual relations in military units which are at variance with or contrary to regulations.

Dialogue forms are being incorporated into ideological-political and internationalist indoctrination, union republic days and 10-day periods are designated, as well as round-table discussions, special evening events, oral magazines, evenings honoring outstanding achievers in combat and political training, personnel being discharged into the reserves, and "I introduce myself to the outfit" get-togethers. Internationalist friendship corners or rooms are set up, and "ethnic cuisine days" are held. A great deal is being done in this area by unit party and Komsomol organizations and interethnic relations groups formed under the auspices of party committees and party bureaus. In many units practice sessions are held on the eve of arrival of new conscripts, involving political workers, party and Komsomol activists, platoon and company commanders, and subunit first sergeants, on receiving and studying new conscripts, and on organizing work with individual newcomers, particularly those who have poor knowledge of Russian. This produces good results. A poll conducted in military units indicated that 71 percent of those compulsory-service personnel polled expressed satisfaction with their mutual relations with their fellow soldiers of other nationalities, 93 percent of Air Force personnel indicated that they make friends with members of other nationalities, and the overwhelming majority of officers and warrant officers noted a fairly high level of cohesiveness within their units and an absence of incidents and criminal actions in which interethnic relations played a role.

We have no grounds to be satisfied or complacent, however. The proceedings and decisions of the 19th All-Union Party Conference, the September and special December (1989) CPSU Central Committee plenums, the CPSU platform entitled "Party Nationalities Policy in Present-Day Conditions," other guideline documents, current realities and the situation in this country at the national level and in certain regions demand that more be done in this work. I would say that the system of internationalist indoctrination and uniting of military units does not yet fully reflect the entire alarm and concern on the part of the party Central Committee with the state of interethnic relations and all guidelines pertaining to restructuring this work. Those changes mentioned above are of an evolutionary rather than a revolutionary nature, which is required by the present stage of perestroyka. For this reason we have both poor standards of interethnic intercourse and unceasing conflicts among military personnel of different nationalities, as well as occurrence of elements of latent and overt nationalism, poor knowledge of the Russian language on the part of many military personnel, disproportions in the ethnic composition of officers and warrant officers, plus many other negative elements.

This state of affairs convinces us that there has not yet been deployed at the unit level a united front aimed at further improving internationalist indoctrination, and that there has not yet been elaborated a new, content-filled general plan for strengthening interethnic relations in Air Force units as well as an up-to-date, effective methodology. Unfortunately in many units work in the area of internationalist indoctrination has not yet been elevated to the status of a priority activity and is being organized without an adequate foundation on the Leninist ideological-theoretical legacy and the results of scientific research, without adequate interlinkage with patriotic, ideological-political and moral-ethical indoctrination and dissemination of legal knowledge. It lacks the requisite comprehensiveness, systems nature, efficiency, selectivity, and scope.

A substantial segment of command and political personnel, party and Komsomol activists has the notion that the results achieved in the area of patriotic and internationalist upbringing accomplished in the family and at school, that is, prior to military service, mean that this work can be left to inertia. This is a profoundly erroneous opinion: nobody is born an internationalist. This quality is not inherited but must be painstakingly learned from childhood and throughout one's entire life. And a particularly important role in this is played by the military which, as emphasized at the 19th All-Union Party Conference, should become a school of internationalist indoctrination.

At the present time, however, many of our units are failing to function as such a school. I would like to cite some additional statistics. More than 40 percent of polled military personnel noted that restructuring of internationalist indoctrination is being impeded by conservative thinking on the part of command and political personnel and the persistent nature of stereotypes which have formed in the organization and content of thinking, and that in the last two years they have noticed nothing new in their units in this regard. More than half of polled commanders and political workers consider themselves to be poorly trained and prepared for the job of controlling mutual relations among military personnel of different nationalities.

Thus I believe that the actual state of affairs in the area of internationalist and patriotic indoctrination of primary-rank enlisted personnel, NCOs, warrant officers and officers is more serious than some commanders and political workers imagine, especially at the regimental echelon and above. One must be concerned by the fact that a certain portion of military personnel are falling into the clutches of nationalist, anti-military, anti-perestroyka elements. This happens wherever there is failure to conduct active, aggressive, effective ideological

work, where an ideological vacuum forms, a vacuum which is immediately filled with an ideology alien to Marxism-Leninism.

In present-day conditions, when conditions are being created for deideologization of society, including the military, within the framework of the new political thinking, democratization, and pluralism of opinions on a broad range of issues, the complacency, sluggishness, and inactivity on the part of many commanders, political agencies, party and Komsomol organizations could be fraught, frankly speaking, with unforeseen ideological-political consequences.

We cannot simply sit with our arms folded waiting for instructions. What are needed are the most aggressive actions, new approaches, genuine restructuring of the existing system of internationalist and patriotic indoctrination, grounded on a new concept, the basic features of which are laid out in guideline party documents. Air Force political agencies, command and political personnel, party and Komsomol organizations must assess without delay, first, the state of affairs in the area of interethnic relations in military collectives, as well as at the level of the military collectives and the rayons, oblasts, and republics in which they are stationed; second, the system of internationalist indoctrination, its effectiveness and, finally, the degree to which personnel are subjected to erosive action proceeding from nationalist, separatist, and anti-perestroyka elements.

Within the spectrum of priority tasks, we can specify the following. It is essential to designate matters pertaining to patriotic and internationalist indoctrination as priority areas of ideological work. The entire process of combat and political training must be used in the interest of these issues, combining the force of conviction and authority of the law and military regulations. The main thing here is to work in advance of need, to stir up the energy of forming patriotic and internationalist consciousness in Air Force personnel, focusing it into a channel of consolidation of efforts aimed at strengthening vigilance and unit operational readiness, increasing the moral-political, patriotic and internationalist potential of the Air Force.

We are impeded by dogmatism, excessive attention to form with harm to content, lack of originality, obsolete methods, and rule by administrative fiat. One should not view ideological work as a means of "supporting" adopted decisions and as a means fostering the passage of commands "down through the echelons." The central focus of ideological work should be the idea of unity of indoctrination and people's socially productive activity, a close link between this activity and the daily life and activities of military units, taking into account the multiethnic composition of military units, military educational institutions and establishments, and forming patriotic and internationalist convictions in personnel.

The role of the Leninist theory legacy pertaining to problems of patriotic and internationalist indoctrination, the Leninist concept of socialism, and Lenin's teaching on defense of the socialist homeland and the principles of forming an army of a socialist state is becoming greater today than at any time in the past. It truly constitutes a wellspring of wisdom, and it must be disseminated by all forms and methods. Persistent, aggressive work should also be conducted on dissemination and affirmation of the vanguard, leadership role of the CPSU, initiator of revolutionary restructuring in this country, a process which aims to defend socialism against all deformations and to give it a humane, democratic character.

It is essential to renew and refurbish internationalist indoctrination not only in word but by the entire structure of the process of training and indoctrination, by strict observance of the requirements of regulations, orders, directives, etc. Officer cadres play an enormous role in this. They should display an example in performance of duty, in off-duty routine, and in interethnic relations. They should be familiar with the needs and concerns of their subordinates, and they should be close to their subordinates. Unfortunately there are still many leader-Communists who proclaim these ideas but who in fact ignore them. They are not interested in the conditions in which primary-rank enlisted personnel and NCOs perform their job duties, they take no interest in their off-duty rest, recreation, and living conditions, in their diet, in ensuring that they are provided with everything they need, and they are unfamiliar with the moods and attitudes of their subordinates. This not only undermines their authority but also does irreparable harm to the entire business of training, indoctrination, establishment of an esprit de corps within military units, as well as their readiness and capability to perform assigned missions. We cannot accept this state of affairs.

I would consider it mandatory to establish at the unit level a continuously-operating system for instructing commanders, political workers, party, Komsomol, and ideological activists in work methods in multiethnic military collectives. It would be advisable to concentrate attention on methodology of individual indoctrination activities and preventive efforts directly in the subunits. The purpose of this is to form in military personnel solid patriotic and international convictions, a strong sense of pride in our multiethnic homeland, readiness and willingness to defend it.

Synthesis and dissemination of the advanced know-how of commanders, political workers, party and Komsomol organizations, assemblies of officers, and women's councils in resolving these problems could be a logical continuation of this work.

In conformity with the demands of the September (1989) CPSU Central Committee Plenum, we must take into consideration the nationalities factor in personnel, party, and Komsomol work. We must seek to ensure that command and political personnel at the unit and subunit

level reflect as fully as possible the ethnic structure of personnel and that appointments be made taking this factor into account. The same principle should form the basis of nominating and promoting Communists and Komsomol members to membership in their committees and bureaus as well as other public organizations. Obviously these problems cannot be resolved solely by shifting around available manpower in the units and subunits. The question must therefore be addressed on a broader scale, addressing the matter of acceptance to enrollment at Air Force schools, academies, and graduation from these schools of officers of various nationality and ethnic affiliation. But we, not somebody else, are the ones to resolve this problem.

Due to objective factors, the number of young soldiers with a poor knowledge of Russian is increasing in Air Force units. This of course greatly complicates organization of indoctrinational work with them and adversely affects the quality of combat and political training. The problem exists, and yet efforts to solve it are extremely unsatisfactory, with old forms and methods being used. We have had enough of these primitive methods. We need a well-defined, well-conceived organization and system. I believe that an important role here should be played by junior aircraft maintenance specialist schools. It is precisely at these schools that we must create the necessary conditions for studying the Russian language and organization of an aggregate of measures in the area of internationalist indoctrination of Air Force personnel.

A great deal in the area of increasing the internationalist potential of the Air Force depends on the activeness of and efficiency on the part of leader-Communists at all echelons, political agencies, primary party and Komsomol organizations, cultural and educational establishments, at practically all levels within the military structure. One can talk a great deal, speak well, and make correct decisions, but when it comes to action—soldiers can be taken out of Russian-language classes and assigned to work details, and combat history rooms can be kept exclusively for special guests, out of fear of soiling the carpet with soldiers' boots.... Recently a Komsomol leader related the problems he had faced in order to hold a "national Uzbek cuisine day" in his unit. The unit commander and political worker showed no interest whatsoever. The food supply service, finance service, and medical service chiefs perceived violations of existing regulations and absolutely refused to find an acceptable solution to the problems. The Komsomol secretary finally was able to carry out his plan, but in the future he will probably think twice before bringing forth any such initiative, for he is now acquainted with the massive wall of administrative procedure, inertia, and lip-service attitude. We must prevent this type of situation from occurring.

Practical realities dictate the need to transition more vigorously and actively from merely taking note of a given problem, related objective and subjective difficulties, and self-critical acknowledgment of oversights and omissions to concrete actions. We see the following as the correct path: skillfully and efficiently resolving urgent issues, taking advantage of initiatives, and overcoming the lag in organizational and ideological indoctrination work behind the processes taking place in multiethnic military collectives. The better and more efficiently we do this, the more genuinely military service will become a true school of internationalism, in which a fighting friendship and brotherhood among Air Force personnel of different nationalities and ethnic affiliation will take solid root as a lofty ethical standard, and an overall striving toward increasing the combat readiness of units and subunits will become consolidated as responsibility for reliable defense of our united homeland.

Integrating Reconnaissance, Strikes on Mobile Ground Targets

90UM0621B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 4-5

[Article, published under the heading "Tactics and Simulation," by Military Navigator 1st Class Col V. Zinko, candidate of military sciences, and Military Navigator 1st Class Maj A. Shikhovtsev: "Reconnaissance - Delay - Kill"]

[Text] Many important airstrike targets are highly mobile and may be found in the most varied locations: in assembly or concentration areas (embarkation/entrucking/entraining and unloading/detrucking/detraining points), in deployment positions, on the march (passage at sea), etc. For this reason they must be hit without delay, that is, immediately after they are spotted.

In the opinion of foreign experts, the level of development of reconnaissance and intelligence-gathering assets and the availability of precision weapons make it possible today to implement the concept of "first-shot kill," which was developed back in the 1960s. It is not without reason considered that the result depends chiefly on effectiveness of reconnaissance. The tasking functions of air reconnaissance forces are becoming greatly expanded in connection with this. In addition to seeking out and finding targets, they are also tasked with weapons guidance and control right up to effective target impact. The "reconnaissance - target designation - kill" cycle has already been implemented in some integrated reconnaissance and strike systems.

Mobile targets can also be successfully engaged, however, with unguided air-delivered munitions. This, however, will require restricting the target's maneuver for a certain period of time, such as by scattering mines. Reconnaissance and strike aircraft, operating jointly and executing close to a real-time "reconnaissance - target delay - target designation - kill" cycle, should take part in performing this mission. The following elements should be incorporated into integrated reconnaissance and

strike forces (RUG): reconnaissance element; target delay or immobilization element; target marking and target designation element; strike element; strike evaluation element. Supporting elements would include EW assets, air cover, ground air defense suppression, etc.

In the general case reconnaissance and strike operations boil down to the following (see following diagram). Reconnaissance aircraft seek out the enemy in a specified area employing combined utilization of specialized equipment. After detecting a target and tying its position to map coordinates or landmarks, the aircrews report this information by prescribed communications channels to the other RUG elements. Intelligence can be simultaneously communicated to ground command and control facilities via communications relay aircraft or satellite.

The target immobilization or delaying element, upon reaching the target, lays mines. The aircraft in the following element illuminate the target (if necessary), mark it with marking and signaling devices, refine the target's coordinates, and communicate this information to the strike element and strike evaluation element leaders. The strike element hits the designated target, and the strike evaluation element records strike results. After this all elements proceed in sequence to the return flight departure point and proceed either to the destination field or to another area.

Reconnaissance is an important phase. The number of reconnaissance aircraft in the element is determined by the size of the search area, time available, and the performance characteristics of the specialized gear. Formation configuration and parameters are selected on the basis of conditions of the tactical environment, capabilities of the reconnaissance assets, precision and accuracy of airborne navigation systems. Modes of search are also determined by these factors. If the reconnaissance element's aggregate effective search sector provides full coverage of the assigned search area, a single pass is flown. Otherwise several routes are selected. In the latter case, the reconnaissance aircraft first position themselves and cross a phase line in order precisely to determine their position relative to the other elements and to set up the proper mutual lateral spacing.

The second phase consists of delaying (restricting mobility) of the spotted target. Depending on the status and nature of the target, the delaying or immobilizing element may plant a blocking-type, a canalizing, or a route-blocking barrier minefield (see following diagram). Maximum effect would be achieved by planting a combination of these types of minefield. Delay time is determined by minefield dimensions and density (see following diagram).

The composition and modes of actions of the aircraft element assigned this mission are determined according to conditions of the target's operation, size and designated delay time, as well as by the types of mines employed. Actions from a common formation with the reconnaissance element and from airborne alert zones can be considered the principal modes. The former is recommended when reconnaissance aircraft are performing search in a designated area in a single pass, while the latter is recommended if reconnaissance aircraft are compelled to fly several passes.

The next phase is marking the target and target designation. The composition of the element for performing this mission depends on the nature of functioning and dimensions of the target, as well as on weather conditions. Marking can be performed by regular T/E marking and signaling devices or with incendiary devices. In all cases they should help ensure that strike element aircrews clearly spot the target when approaching it from any direction, at a distance adequate for performing targeting or aiming procedures and effective weapons delivery. When necessary (at night), the target is also illuminated with parachute flares.

Target designation consists in refining the target's coordinates, composition and parameters of movement, in determining the target's principal elements to receive priority attention by the strike element, and transmission of this information to the strike element and strike evaluation element leaders. Information is transmitted via specified radio nets, using code tables or coded grid overlays.

The main phase is destruction of the detected and marked target. The strike aircraft force composition is determined by current conditions of the tactical environment, type, nature, specific features of functioning or operation, composition and prescribed degree of damage to be inflicted on the target, as well as capabilities of airborne bombsight/target engagement systems and weapons to be employed. In various specific cases strike elements may operate within a single common RUG formation, from airborne alert status, or from the ground. The effectiveness of their actions is determined in large measure by how the other elements have performed their missions.

The final phase is strike evaluation. It is performed in order to assess the actions of the strike elements and accomplishment of their mission. It is sufficient to assign one or two reconnaissance aircraft to the strike evaluation element. Their modes of action will be determined by conditions in the target area and the capabilities of their specialized onboard equipment. They can be accompanied by several strike aircraft, tasked with performing missions which may suddenly arise.

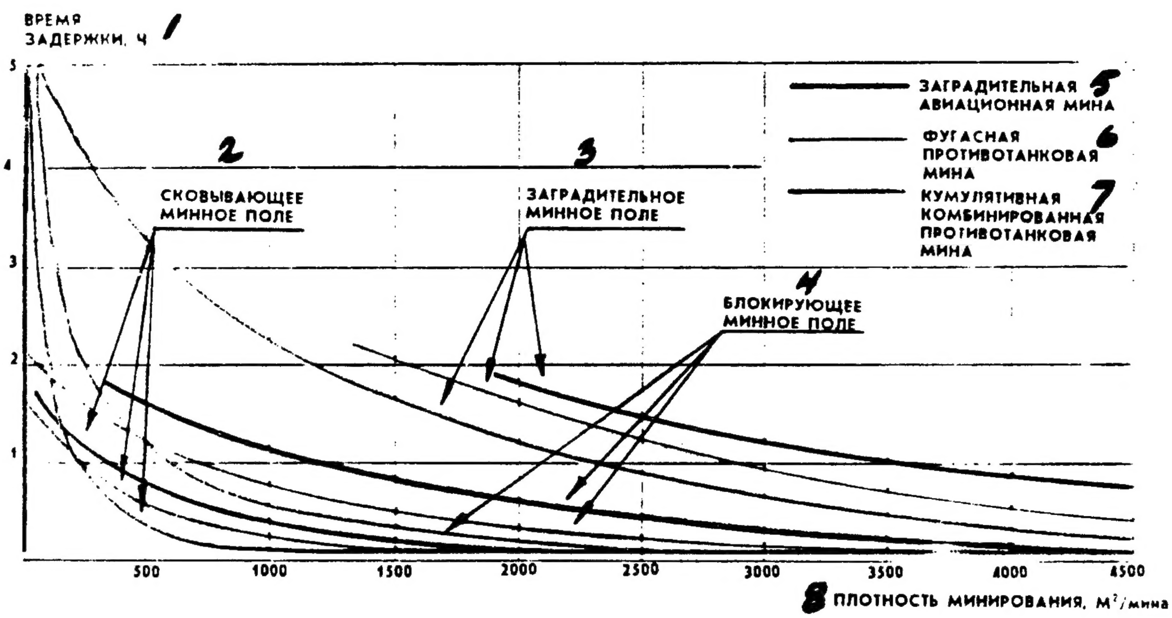
We have discussed above the principle and one variation of integrated reconnaissance and strike operations. The number of RUG elements may vary from one mission situation to the next. Several tactical force elements can be combined, or missions can be integrated for individual elements. The above approach to this problem, however, will unquestionably help increase effectiveness of striking mobile targets and will help reduce the required forces and combat assets.

Integrated Reconnaissance and Strike Operations Diagramed

90UM0621C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 24-25

[Graph and Diagrams: "Integrated Reconnaissance and Strike Operations (a variation)"]

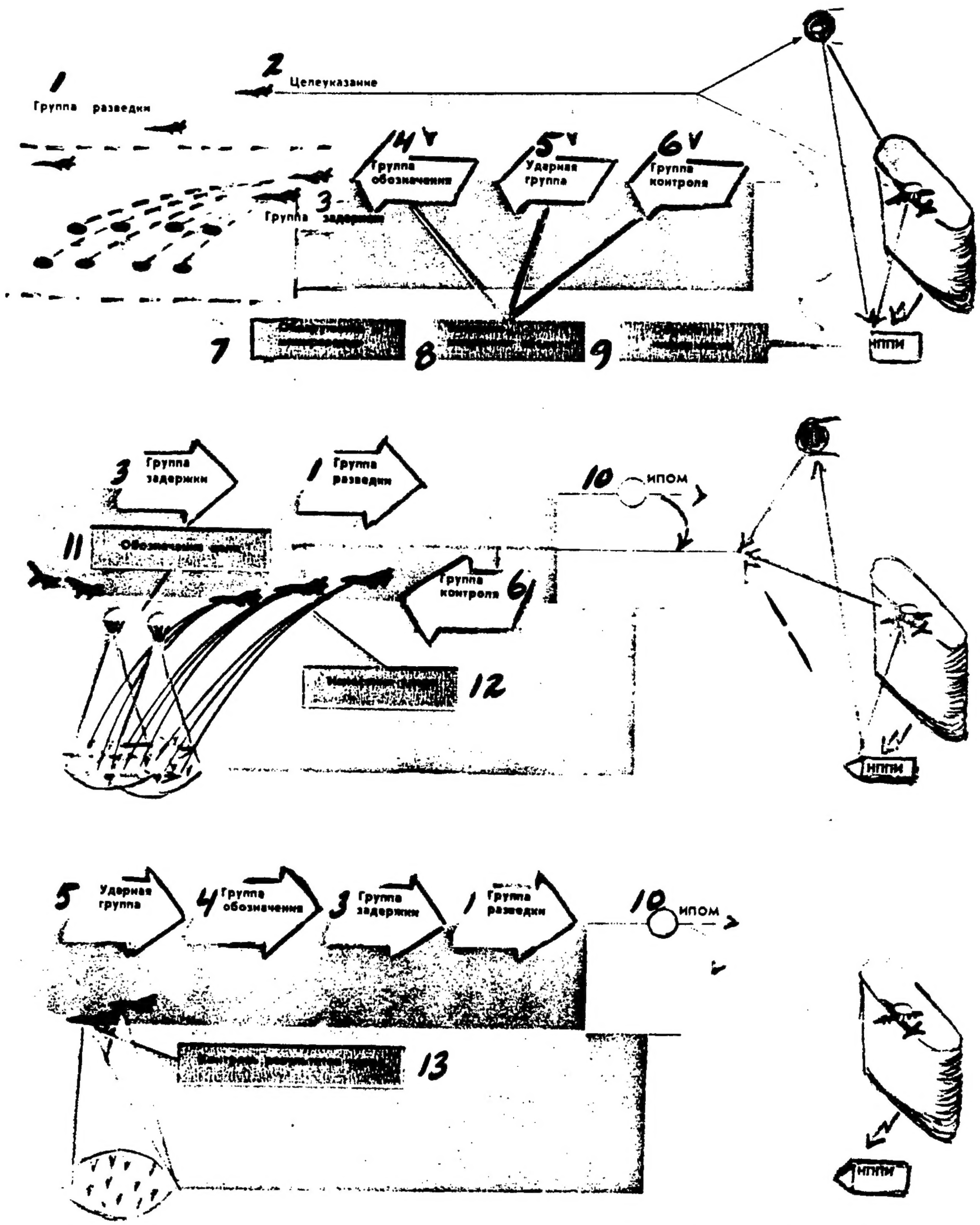
[Text]



Key:
1. Delay time, hours
2. Canalizing barrier minefield
3. Route-blocking barrier minefield
4. Blocking-type barrier minefield
5. Aircraft-laid barrier-field mine
6. Blast type antitank mine
7. Vertical-penetration/horizontal effect shaped-charge antitank mine
8. Minefield density, sq m/mine

Types of Minefields

Key:
1. Blocking-type barrier
2. Canalizing barrier
3. Route-blocking barrier



1. Reconnaissance element
2. Target designation
3. Delay element
4. Marking element
5. Strike element
6. Strike evaluation element
7. Detection and emplacement of mines
8. Proceed to coordinates of target
9. Information processing
10. Return flight departure point
11. Marking target
12. Strike delivery
13. Strike evaluation

Ethnic Compatriots Visit Air Force Units

90UM0621D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) p 5

[Article, published under the heading "In the Air Force Political Directorate": "Ethnic Compatriots Visit Air Force Personnel...."]

[Text] Pursuant to the decisions of the 19th All-Union Party Conference and the September (1989) CPSU Central Committee Plenum, which adopted the CPSU platform "Party Nationalities Policy in Present Conditions," and in conformity with instructions issued by the USSR Minister of Defense and the chief of the Main Political Directorate of the Soviet Army and Navy, more intensive work is being conducted in the Air Force pertaining to restructuring and improvement of internationalist indoctrination of personnel and cohesiveness within multiethnic military units. Analyzing the progress of these efforts and the results achieved, the Air Force Political Directorate notes that in recent years this work has become enriched with new approaches, forms, and methods.

There has been a substantial increase, for example, in the number of visits to Air Force units and bases by official delegations from union republics, krays and oblasts, as well as representatives of various public organizations. Such visits are made both at the invitation of the command element and political agencies as well as at the initiative of the ethnic compatriots of Air Force personnel. The get-togethers help strengthen bonds between military collectives, party and soviet agencies, Komsomol committees, enterprises and schools, help strengthen internationalist indoctrination of military personnel, and help dispel slanderous rumors and fanciful conjectures about alleged infringement of rights and wounding of the ethnic sensibilities and dignity of military personnel representing a number of union and autonomous republics, krays and oblasts.

In view of these and other factors, the military council and political section of Far Eastern Military District air forces submitted a proposal to Communist Party and Komsomol central committees of all union republics that they send delegations to the district's Air Force units. Our Uzbek comrades were the first to respond to the invitation. Over the course of a week's time a group headed by Uzbek Communist Party Central Committee member S. Kadyrov, deputy to the Uzbekistan Supreme Soviet, visited Air Force units and subunits and got together with more than 2,000 Air Force personnel of Uzbek nationality alone.

The compatriots became acquainted with the men's daily life and activities, organization of combat and political training, training facilities, and aircraft. The visitors in turn told of progress in perestroyka processes in the republic and responded to the airmen's questions. The group was received by the party kray and city committees and at the Far Eastern Military District air forces political section.

An appeal by military personnel of Uzbek nationality stationed in the Far East directed toward all armed defenders of the Soviet Union constituted a unique emotional response to these get-togethers.

Equally moving and memorable was a visit to an Air Force base in Belorussia by a Georgian delegation headed by Signatskiy Rayon party committee secretary V. Sabutashvili. As they bade farewell to the airmen, the visitors expressed the desire to establish closer patron ties to the base and to arrange to send conscripts from their rayon to this garrison to perform their military service.

Carpathian Military District air forces political agencies are conducting a persistent search for ways to improve internationalist indoctrination and cohesiveness of multiethnic military units. At the initiative of the political section, for example, a Moldavian SSR day was held at one of the Air Force garrisons. It included participation by a 60-person delegation from Moldavia's Dondyushanskiy Rayon. In addition to get-togethers and discussions, exhibits of folk artistic creativity were organized in the course of this special day, and dishes from the ethnic cuisine were prepared and sampled. Concerts were held at the garrison and in town through the joint efforts of Air Force amateur performance groups and the visitors. This experience subsequently helped in holding similar friendship events in other district Air Force units.

Lending total support to any and all useful initiatives in efforts in the area of internationalist indoctrination, the Air Force Political Directorate at the same time directs the attention of commanders, political workers, party and Komsomol organizations, as well as the military community to possible attempts to utilize visits to Air Force units and other forms of communication between military personnel, ethnic compatriots and the local population for disseminating alien ideas and attacking the military.

A group of women acting on behalf of the commission on republic youth military service affairs under the Presidium of the Lithuanian SSR Supreme Soviet visited an Air Force unit in the Moscow Military District at its own initiative and without arranging things in advance with military authorities.

The pretext for visiting this unit was an incident involving mutual verbal insult, with culpability both on the part of Uzbek Private Bokolonov and Lithuanian Private Butkyavichus. The visitors, including Butkyavichus's mother, were given the opportunity to look into the causes of the conflict on their own and to interview anybody they liked. As they were taking their leave, the women stated that they had no complaints against the unit authorities. Soon after their departure, however, they USSR Ministry of Defense received a letter, the authors of which noted the difficult conditions of service for military personnel of Lithuanian nationality, including in the visited Air Force unit, and demanded

the forming of ethnic military units, in which there would allegedly be no difficulties.

At the present time this is an isolated case, but it is typical of actions by nationalist elements seeking to sow seeds of discord in the harmonious military family as well.

Giving high marks overall to the experience and indoctrinational significance of visits to Air Force garrisons and units by delegations from the RSFSR, the Georgian, Lithuanian, Moldavian, and Uzbek SSR, the Air Force Political Directorate recommends that political agencies, party and Komsomol organizations support and further develop this useful initiative, seeking new and effective forms of internationalist indoctrination of military personnel, ways to unite Air Force collectives and strengthen the unity between the people and the military.

Advisability of Practical Stall, Spin Training Debated

90UM0621E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90(signed to press 31 Jan 90) pp 6-7

[Article, published under the heading "Into the Military Pilot's Arsenal," by Docent Colonel G. Rayevskiy, candidate of technical sciences: "Should the Spin Be Taught?"]

[Text] When the latest version of the L-39 trainer entered service with training regiments at higher military aviation schools for pilots, flight personnel noted that they were more sluggish in entering an intentional spin, that they behaved somewhat differently in a spin than earlier versions, and they showed greater delay in spin recovery. In some instances aircraft have failed to recover from a spin, and the pilots have been forced to bail out. For this reason training flights to practice spins, which in the past had been mandatory for every pilot and student pilot, were prohibited.

Experts believed that a possible worsening of spin characteristics was connected with a number of design changes: a decrease in rudder surface area and an increased aircraft empty weight and maximum permissible aftward center of gravity (reduced center of gravity range). In order to determine the actual causes of the noted phenomena, special flight tests were performed on aircraft of different versions, in which they precisely determined the stability and controllability characteristics at high angles of attack, during stall and spin, taking into account possible pilot errors in flying technique. Occurring instances of significant aircraft delay in stall recovery and peculiarities in aircraft behavior were thoroughly analyzed on the basis of flight data recorder tapes.

As a result it was established that the behavior of the new-version aircraft at high angles of attack, during stall and spin does not differ substantially from that of its predecessors. Stall recovery is practically without delay when the controls are placed in neutral position. The new aircraft also unhesitatingly enters a spin at low speed from level flight with full rudder and stick back when bank angle reaches 45°. As in in the past, the nature of these conditions is determined by airspeed at entry and direction of entry. A left-hand spin is more uniform than a right-hand spin. Spin recovery characteristics differ slightly, although delay increases with an increase in number of turns.

Does this mean that pilot errors and lack of pilot proficiency are fully to blame? Not entirely. We know that even slight peculiarities of a new aircraft can affect the actions of pilots with firm skills in flying earlier-version aircraft. The situation can become aggravated by the pilot's emotional state when flying in a critical configuration or when unexpectedly entering critical conditions. But incidents also directly involving pilot error are fairly common as well. Analysis of flight data recorder tapes confirms this assumption.

Figure 1. Record of Flight Parameters During Execution of a Spin by Pilot S. Bondarenko.

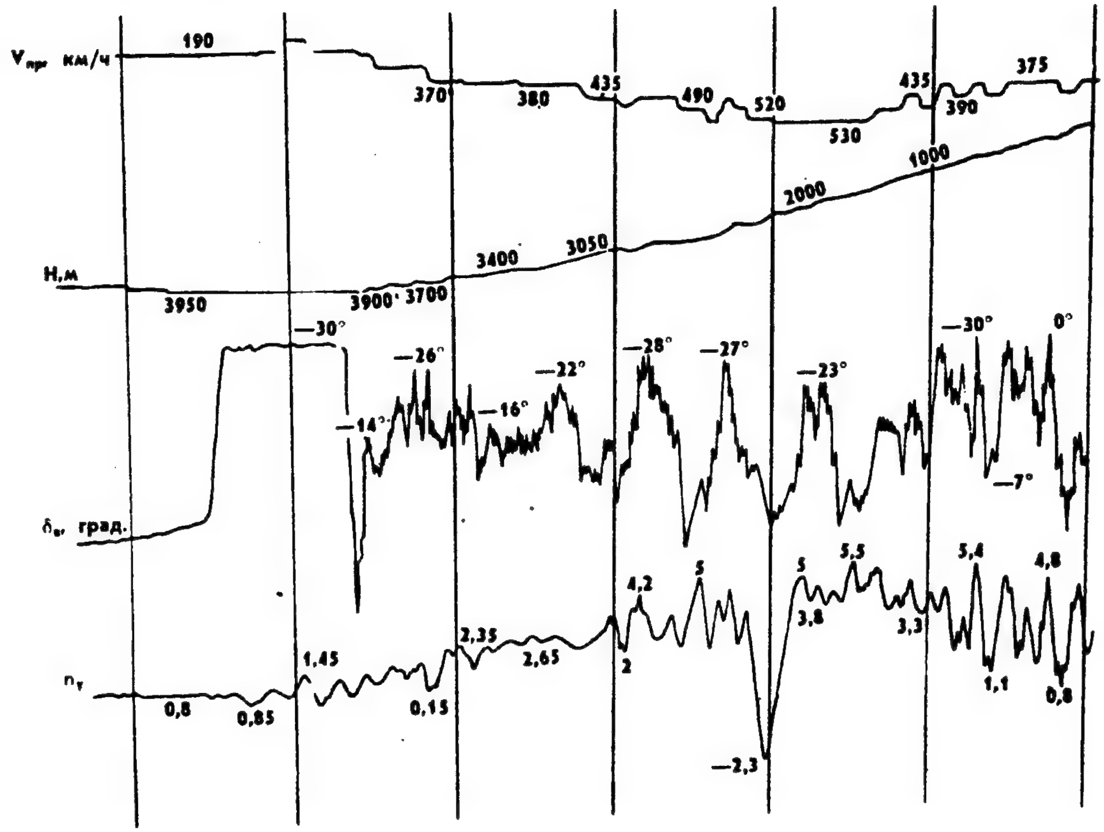
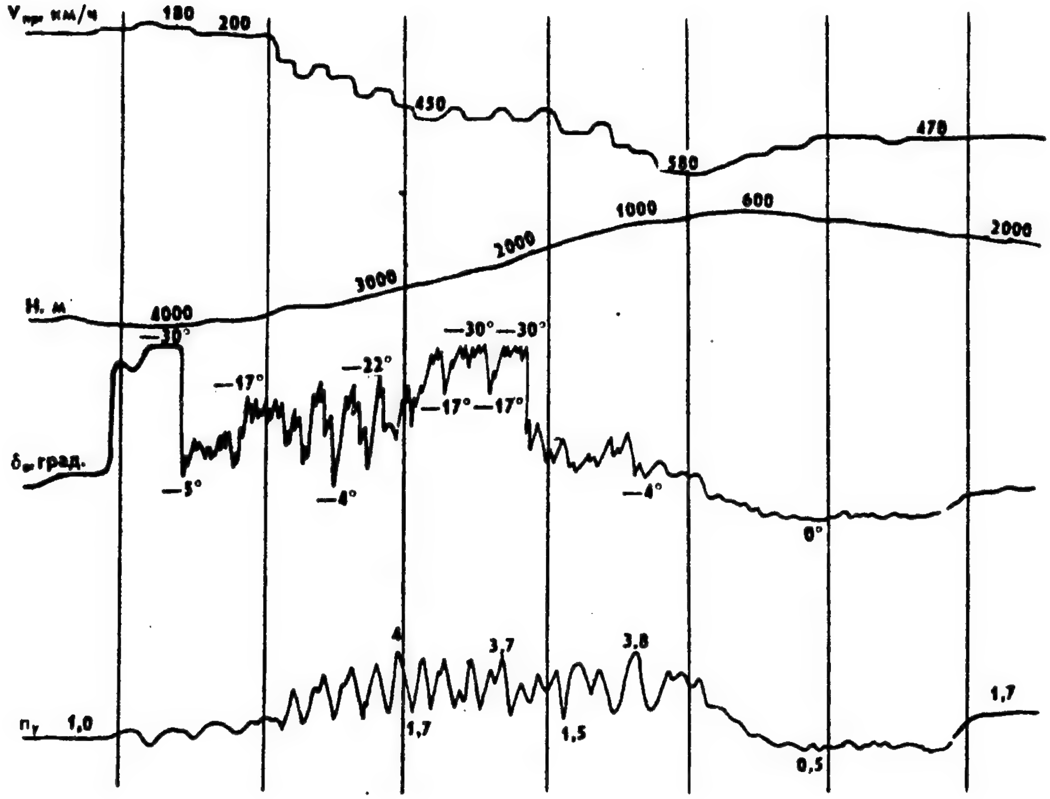


Figure 1 contains a flight data recorder tape record of parameters during execution of an intentional spin by Lt S. Bondarenko. Following spin entry and completion of one full turn, the pilot pushed the control stick forward past neutral, where it remained less than a second. This was followed by holding the stick for an extended time (15 seconds) half-travel aftward, with subsequent periodic deflection from neutral position to full aft travel. These actions brought the aircraft to precritical angles of attack when the stick was pushed forward and to an increase in airspeed to 500-550 km/h with the aircraft subsequently entering stalling angles of attack. The fact that the aircraft may have been in a steep descending spiral made the pilot's actions more difficult, since the nature of this motion was determined, taking into account slip and rotation in the direction of bank, by wing twist caused by autorotation at stalling angles of attack. The pilot's faulty actions led to an air mishap.

Let us examine the following incident. Following recovery from an intentional spin, an aircraft being flown by pilot V. Kostin and V. Tlustov, entered a steep descending spiral in spite of the fact that all controls were held in the neutral position. The pilots, taking the spiral to be a spin and deciding that the aircraft was incapable of recovery, ejected.

What was the reason for this? Practical flying experience and additional testing confirmed that when the control stick is in the full rear position, the aileron and elevator trim control switch, "catching" on the pilot's parachute harness straps and clothing, causes these surfaces to deflect, sometimes to full deflection. At a high airspeed a deflected aileron trim tab generates considerable rotational moment on the roll axis, while the elevator trim tab appreciably alters longitudinal control channel forces on the stick.

Figure 2. Record of Flight Parameters During Spin Flown by Pilot N. Vlasik.



Another typical pilot error is to place the stick in neutral not on the basis of elevator position but according to forces, although it is known that zero forces during spin recovery correspond to a 12-15° pitch-up elevator deflection. With this elevator position the aircraft will not recover from the spin. As an example, Figure 2 shows actions by Lt N. Vlasik during a spin. The pilot pushed the stick forward to initiate spin recovery, but he failed to push the stick as far as neutral position (the elevator remained in a 5° pitch-up position). During the next five seconds he held it in an 8-12° elevator position with subsequent full-travel aftward displacement of the control stick. Brief control stick excursions to neutral failed to produce successful results. Finally, after 35-40 seconds, moving the stick forward and holding it close to neutral resulted in spin recovery. And yet all this was viewed as aircraft delay in spin recovery.

This does not exhaust the list of typical pilot errors, but the possibility of their occurrence decreases when the pilot properly height-adjusts his seat. If the seat is adjusted to abnormal height, such as in order to improve visibility, there will be reduced capability to push the control stick forward beyond neutral position, which can lead to "delay" in spin recovery. A decrease in pilot errors can also be promoted by periodic cockpit drill sessions on pilot actions in spin recovery, with particular attention focused on correct placement of the control stick into neutral or slightly beyond neutral position (up to one fourth stick forward travel). In this case the pilot must be reminded of the required forces (up to 30 kg) and strong control stick vibration. Poor body positioning in the seat leads to errors. A poorly "secured" pilot does not control the aircraft but holds onto the stick, which can "break loose" from his hand.

When a delay occurs in spin recovery after the controls are moved to recovery configuration, one should display self-control, verify position of control surfaces, and not be in too much of a hurry about moving the controls. The aircraft may show a delay up to a full turn (3-6 seconds) from the moment the controls are moved to initiate spin recovery. When manipulating the control stick during maneuvering, it is advisable to proceed as when one is in an undetermined attitude. The controls should be placed in neutral position and held there until aircraft rotation ceases.

But are these recommendations, unreinforced by habit, the only solution to the problem?

As already noted, at the present time the spin is not taught on L-39 aircraft. Demonstrating stalling to student pilots is limited to showing how the aircraft behaves at high angles of attack, with buffeting, practically in

level flight. One wonders about the advisability of this approach. Flight safety with maximum utilization of the aircraft's maneuver capabilities during student pilot training can be achieved in two ways. The first is to teach them to fly in such a manner as never to get into stalling and spin conditions, that is, at the slightest indication of buffeting they would immediately reduce rearward force on the control stick until buffeting ceases. The second way is to demonstrate stalling and spin conditions to the student pilots and to teach them both stall and spin entry and recovery in all possible variations.

We are currently using the first of these methods, but we are as yet unable to prevent instances of students and pilots from getting into stalls and spins. There are fairly frequent instances of stalling the aircraft in the upper part of a loop and Immelmann and in the initial phase of the half roll. A confidential survey of the cadets of a certain air squadron indicated that when flying a loop only one person had on no occasion dropped below minimum controllable airspeed at the top of the maneuver. These were isolated occurrences for some of the student pilots. Most of the cadets, however, dropped below minimum controllable airspeed on practically every loop they flew. In order to avoid this when performing vertical ascending aerobatic maneuvers, it was decided to increase indicated airspeed during entry from 600 to 650 km/h. This reduced the probability of encountering critical conditions, but it did not totally eliminate such situations. In addition, since student pilot training excluded virtually all experience with stalling and spin entry, they perceived as stall or spin entry aircraft turning motion when applying excessive rearward pressure on the control stick during a maneuver. Responding as instructed by the Aircraft Operating Manual, they would turn the controls in the direction of rotation, execute spin entry procedure, and then effect spin recovery (this can still be done on the L-39).

A confidential survey conducted among flight instructor personnel flying the MiG-21 indicated that many of the pilots do not fully utilize the aircraft's maneuver capabilities during buffeting, in spite of the fact that stalling will not occur until the angle of attack becomes considerably greater. For all practical purposes they are not prepared for this, since when flying the trainer stall and spin entry are considered hazardous and therefore prohibited. They have been taught not to fly in these configurations, not to mention the fact that most flight personnel are simply unprepared psychologically to respond in a stalling or spin situation. What could one then expect in actual air-to-air combat?

In conclusion we should note that pilots who in the past have intentionally stalled and have flown intentional spins and who are greatly in favor of such training would like to teach these skills to student pilots. But those who lack such past experience object to this training, placing their hopes on the requirements of ensuring flight safety. Which of these two approaches is the optimal one and most fully satisfies the objectives of training the military pilot as a combat flier? It is high time to give an unambiguous answer to this question.

Psychological Reasons For Pilot Error Considered

90UM0621F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 8-9

[Article, published under the heading "Flight Safety: Experience, Analysis, Problems," by N. Nosov, candidate of psychological sciences, chief psychologist, Medical Directorate, Ministry of Civil Aviation: "Gear Retracted During Rollout"]

[Text] We know that a pilot retracts his landing gear during his landing roll as a consequence of the fact that for some reason he confuses the gear extension switch with some other control, such as the propeller setting disengage switch. Mistakes are also made during flight. There are a fair number of explanations why this happens. But in practically no investigation of such pilot errors is a thorough psychological analysis performed, an analysis which should mandatorily include an investigation of the subjective aspect of the incident, that is, the state of consciousness of the "pilot in error" (AVIATSIYA I KOSMONAVTIKA, No 9, 1989). This is due in part to the fact that this analysis procedure is fairly complex and should be performed by a qualified psychologist. But we are always short on time, specialist personnel, and resources. Nevertheless it is high time to face the problems of pilot psychology.

...A propeller-driven aircraft was coming in too low on a landing approach. The flight engineer watched closely as the captain guided the aircraft in. At the proper moment the pilot issued the prescribed command: "Cut throttles. Disengage prop setting." The flight engineer, continuing to observe the aircraft's progress, cut the throttles, retracted the landing gear (!), and reported to the captain: "Throttles cut. Props disengaged." Soon the aircraft began to sink onto its fuselage as it traveled down the runway, and a scraping of metal was heard. The flight engineer initially assumed that this was happening because tires had blown. Later, realizing that the aircraft had been sliding on its belly, he thought that a landing gear failure had occurred. And it was only later, when he directed his attention to the controls and saw that the gear selector switch was in the up position, did he realize that he had retracted the landing gear instead of disengaging the propeller setting.

As he was performing a faulty procedure (activating the landing gear control), the flight engineer was sure that he was performing the right procedure (disengaging the prop setting). Consequently these two procedures were indistinguishable for the flight engineer at this moment. Thus the error in question is grounded on failure to differentiate between two different procedures. The significance of such an error as confusing one thing for another is established only by an external fact (the flight

engineer retracts the landing gear at that moment when he is supposed to be disengaging the prop setting). From an internal standpoint, however, there is no confusion—he is doing precisely what he intends to do: Subjectively he is performing the correct procedure. The phenomenon of being sure that one is performing one procedure when performing another is called "the phenomenon of failure to distinguish." Thus the reason for the error is the occurrence of this phenomenon, that is, inadequate awareness of the act being performed.

This fact discovered by us had not been described in aviation psychology precisely because through the entire history of aviation no complete psychological analysis of confusion-type errors had been performed.

The reason for inadequate perception is certain mechanisms of the psychological makeup which are inherent in all individuals, and it is not the flight engineer's culpability but rather his misfortune that circumstances dictated that these patterns were manifested at a specific moment. This was fostered by the fact that, first of all, the methods of activating these controls differ very little: both lie in the same plane of movement of the right hand and are performed by very similar finger movements. Secondly, during takeoff the flight engineer activates precisely the gear selector switch after having advanced the throttles, that is, to a different position, but also an extreme position. Thirdly, after performing the first part of the procedure (moving the throttles), one's hand ends up next to the landing gear selector switch. There is definitely a similarity in the procedures of activating both controls, which provides the possibility of making them identical in one's consciousness. Apparently any of similar factors, just as their composition, could have caused the error.

All this is obvious. And nevertheless specialists' efforts are frequently directed, when investigating accidents, toward explaining why a pilot confused controls rather than toward determining why he failed to perceive that he was confusing the controls. As we see, there are very many factors which can cause this confusion between controls. And if it were not for consciousness, which clearly defines difference and similarity, a pilot would constantly be making such confusion-type errors. The following incident shows that actually any factor can give rise to confusion.

During a landing approach the flight engineer, in response to the captain's command, is supposed to extend the flaps to 38° with the rocker switch (at a strictly-determined moment about which he is well informed). At the proper moment the captain ordered: "38 degrees," meaning "Lower flaps to 38 degrees," since there could be no other normal-sequence command than "Lower flaps to 38 degrees" at that moment, and the captain was sure that the flight engineer was well aware of this fact. But at this moment the flight engineer, who was monitoring engine operation, was watching the throttle position indicator (measured in degrees; fuel flow is adjusted by the throttle levers) and holding his hand on the throttles. In response to the command, the flight engineer began increasing fuel flow (airspeed began to increase), advancing the throttles to a position corresponding to 38° on the throttle position indicator, which in the given situation was a totally absurd action. And it was not until the captain, who noticed the airspeed increasing, made a comment that the flight engineer realized what he was doing (and, we might add, became horrified).

Lack of analysis of the internal aspect of an airman's actions can lead to erroneous assumptions pertaining to combating errors.

Well-known American aviation psychologists P. Fitz and R. Jones gathered a large quantity of descriptions of the externally-expressed portion of confusion errors made by pilots. As a result of their analysis they concluded that the following factors form the basis of confusion-type errors: Absence of uniformity of placement of control elements in relation to one another; particular sequence of operations; similarity in design and construction of control elements. Since each of these factors, in the authors' opinion, complicates the pilot's job (one must adapt to a diversity of control elements in different aircraft; special efforts are needed to distinguish between elements located close to one another; one must combat automatism in control manipulation sequence; one must be able to distinguish between similar elements), it is necessary to simplify the pilot's job, which will lead to fewer mistakes.

In the opinion of Fitz and Jones, simplification is the most adequate means of making the job easier. In particular, this is the basis of their recommendation pertaining to landing gear control elements: the landing gear procedure should be simplified in such a manner that only a single-step operation is required of the pilot. As our analysis indicated, however, simple elements which differ little in manner of manipulation create a greater chance of inadequate perception of an incorrect action.

Here is another example. Recently a flight engineer proceeded to raise the flaps on the captain's command: "Cut throttles. Disengage prop setting." It was assumed that such a mistake is caused by the similarity between the procedures of raising flaps and disengaging the prop setting and the proximity of the corresponding controls. It was suggested that the position of one of the controls be changed in order to minimize the similarity. It was decided to exchange places between the prop control and fuel shutoff valves.

After this suggestion was implemented, ten years of operational experience indicated that errors involving confusing flap and prop controls had indeed disappeared, but errors involving confusing prop controls and gear selector switch had appeared (we have discussed these errors). That is, implementation of the suggestion led to migration of the error.This situation can be explained as follows. The change did not alter in one's consciousness the status of the procedure

of prop setting disengagement. Since gear selector and prop controls possess similar characteristics, instances of confusing these controls without realizing it are quite understandable.

There exist various techniques for ensuring adequate perception of procedure execution.

A direct way to combat errors involving activating controls without realizing it is to increase the duration of procedure time, including execution delay, in order to create a time interval essential for full realization. Delaying procedure execution is a widespread technique used in aviation to increase procedure time. Some flight engineers also have reported using this technique: "I do not immediately carry out the captain's command; I wait one or two seconds in order to grasp what is happening." Test pilot M. Gallay noted this same fact: "Having three seconds, for example, at his disposal, a good, experienced operator will not immediately execute, utilizing only half a second, even if he is essentially capable of doing so. He drags out his actions by one and a half or two and a half seconds, 'readdressing' the excess time at his disposal in order to ensure that his performance is maximally reliable and flawless...."

Repeating aloud critical commands before executing them helps create delay. Specific speaking aloud, that is, conscious monitoring of execution, can be observed during aircrew practice sessions on the flight simulator. The flight engineer, when carrying out commands, states aloud what he is to do and what he should not do. For example: "I am turning off the fuel shutoff valve to the starboard engine, not the port engine." Making the control manipulation procedure more complicated helps increase execution time: the presence of locking devices, safety devices, caps, etc, which make procedures two- or three-step.

A method of preventing errors which involves reorganizing procedures is interesting: a flight engineer, aware from the experience of colleagues that it is possible to confuse the prop and gear selector control, asks the first officer to disengage the prop setting.

Nevertheless subjective means do not always work, since there exists the possibility that they will not be used. Experience shows, for example, that the requirement that a command be repeated aloud is fairly frequently ignored, for various reasons, both subjective (disinclination to carry out the primitive recommendations of the operating manual, etc) and objective (the need to execute the command immediately, etc). In addition, repeating a command aloud sometimes does harm, since with occurrence of the phenomenon of failure to distinguish, it is grounded on false confidence and deludes the captain. Mechanical repeating aloud is also possible. For this reason a "struggle for awareness" with the aid of objective factors—special design and layout of controls and displays—is more reliable. This means that when designing and laying out aircrew procedures, special design measures should be taken which ensure adequate pilot awareness of what he is doing.

It is important to bear in mind of course that objective means, created without considering psychological patterns and mechanisms, can themselves cause occurrence of errors, as is indicated by the following example. During a practice flight while breaking in a new captain, the starboard engine failed just prior to lowering the landing gear. The captain ordered the starboard engine shut down. The flight engineer-instructor, preparing to perform this procedure but continuing to monitor the gear position indicator, flipped up the caps on both fuel shutoff valves with his thumb. He flipped up both caps because he was extending the landing gear at this time and was not about to divert his attention to distinguish between the two caps.

One should consider the fact that it was a training flight and that shutting down a dead engine is a quite routine procedure for the flight engineer. After flipping up the caps, he lowered his hand in a mechanical motion and placed his thumb on the partition separating the two fuel shutoff valves. The partition has a sloping surface. This sloped surface caused an involuntary hand movement, which took place with the palm tilted to the left, since his fingers, which were curled back into a fist, hindered the hand from moving horizontally, The left fuel shutoff valve was caught and switched off in this motion—the port engine shut down. Thus in this case the partition, which was specifically designed for differentiating between fuel shutoff valves, helped cause the mistake.

I believe that the examples we have cited persuasively demonstrate the fact that there should be more solid communication between aviators and the Ministry of Aviation Industry. Unfortunately this is lacking at the present time. For this reason the attention of design engineers is not always directed to the peculiarities in the operation of a given aircraft.

Bomber Mission Flight Calculations Described

90UM0621G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 12-13

[Article, published under the heading "The Aviator and the Computer," by Military Navigator 1st Class Lt Col V. Yeguyekov, candidate of military sciences: "Mission Flight-Planning Calculations"]

[Text] The proposed flight calculations for a long-range bomber are performed on an Elektronika MK-52 programmable electronic calculator. One determines the elements of a spherical triangle, to which, depending on the problem being solved, corresponding values and names are assigned (the substitution method). Two sides (a, c) and angle (B) constitute the input data. Unknown parameters are calculated with the formulas for the sines, cosine of the side, and five elements: the third side (b) and adjacent angle (A). It is assumed that the principal great-circle arc coincides with the meridian of the initial setting of the inertial navigation system.

1. Calculation of leg (true) [EPU] and great-circle course angles [OPU] and distances between route salient points (TIM).

Substitution: $A = \pi/2 - B_2,\ c = \pi/2 - B_1,\ B = L_2 - L_1,\ A = \text{ЭПУ},\ в = S.$

$$\text{ОПУ} = \text{ЭПУ} + \operatorname{arctg}[\operatorname{tg}(L_б - L_1)\sin B_1].$$

where L_1, B_1 -- geodetic longitude and latitude of point for which OPU is determined (TIM of beginning of route leg); L_2, B_2 -- geodetic longitude and latitude of following point (TIM of end of leg); EPU -- leg (true) course angle; S -- distance between TIM; $L_б$ -- geodetic longitude of base meridian.

Instructions for Program 1.

№ пп	Набрать число (1)	Выполнить команду (2)	Результат (3)
1.	Р—ГРД—Г в положение (4) «Р»	ВКЛ [F] [ПРГ]	00
2.	Ввести программу (5)		
3.		[F] [АВТ]	0
4.	57,3	[x→П] [0]	57,3
	6368	[x→П] [д]	6368
	180	[x→П] [a]	180
5.		[F] [π]	3,14159
	2	[÷]	1,57079
	B_{i+1}	[—] [x→П] [1]	а, рад
6.	L_{i+1}	[B↑]	L_{i+1}, рад
	L_i	[—] [x→П] [2]	B, рад
7.		[F] [π]	3,14159
	2	[÷]	1,57079
	B_i	[—] [x→П] [3]	с, рад
8.	$L_б$	[B↑]	$L_б$, рад
	L_i	[—] [x→П] [9]	$L_б - L_i$, рад
9.	B_i	[x→П] [4]	B_i, рад
10.		[B/O] [C/П]	ЭПУ$_i$, град
		[C/П]	ОПУ$_i$, град
		[C/П]	S_i, км
11.	Для вычислений по другому варианту перейти к п. 5. (6)		

Key: 1. Enter number; 2. Execute command; 3. Result; 4. To position. 5. Load program; 6. For computations using other variation, go to No 5

Program 1.

00 П→x1	01 F sin	02 x→П5	03 П→x2	04 F sin
05 ×	06 x→П6	07 П→x3	08 F sin	09 x→П7
10 П→x1	11 F cos	12 x→П8	13 ×	14 П→x3
15 F cos	16 x→Пв	17 П→x5	18 ×	19 П→x2
20 F cos	21 x→Пс	22 ×	23 —	24 П→x6
25 ↔	26 ÷	27 F tg^{-1}	28 П→x0	29 ×
30 Fx≥0	31 34	32 БП	33 36	34 П→xa
35 +	36 С/П	37 Fx≥0	38 41	39 БП
40 44	41 П→xa	42 +	43 С/П	44 П→x0
45 ÷	46 П→x9	47 F tg	48 П→x4	49 F sin
50 ×	51 F tg^{-1}	52 +	53 П→x0	54 ×
55 С/П	56 П→x8	57 П→xв	58 ×	59 П→x7
60 П→x5	61 П→xс	62 ×	63 ×	64 +
65 F cos^{-1}	66 П→xд	67 ×	68 С/П	

Example 1.

$B_1 = 48°55'55''$ (0,854 рад), $L_1 = 8°38'45''$ (0,151 рад).
$B_2 = 49°13'08''$ (0,859 рад), $L_2 = 7°44'32''$ (0,135 рад).
$L_6 = 8°47'30''$ (0,153 рад), $i = 1$.

Calculation results: $ЭПУ_1 = 115,84412°$, $ОПУ_1 = 115,93051°$, $S_1 = 73,9363$ км.

Time for calculations and recording results, 40 seconds.

2. Calculation of angles and turn linear allowances, length of legs and flying time.

Designations:

$УР_i$, R_i -- aircraft turn angle and radius at start of leg;

$УР_{i+1}$, R_{i+1} -- aircraft turn angle and radius at end of leg;

$ОПУ_i$ -- great-circle course angle of preceding leg;

$ОПУ_{i+1}$ -- great-circle course angle of current leg;

$ОПУ_{i+2}$ -- great-circle course angle of following leg;

V -- airspeed;

$S_{i,i+1}$ -- distance between TIM (programmable points) of current leg.

Leg length is determined with the formula:

$$S_{\text{эт}} = S_{i,\,i+1} - R_i(\text{tg}\,\text{УР}_i/2) - R_{i+1}(\text{tg}\,\text{УР}_{i+1}/2) + $$
$$+ 0{,}0175\ R_i\,\text{УР}_i.$$

During flight from flight departure point to waypoint (when they coincide with the course of the following leg):

$$S_{\text{эт}} = S_{i,\,i+1} - R_{i+1}(\text{tg}\,\text{УР}_{i+1}/2), \text{ т. е. } R_i = 0.$$

When flying to a target or other waypoint (TIM) ending at that point:

$$S_{\text{эт}} = S_{i,\,i+1} - R_i(\text{tg}\,\text{УР}_i/2) + R_i\text{УР}_i\,0{,}0175, \text{ т. е. } R_{i+1} = 0.$$

Instructions to Program 2.

№ пп	Набрать число (1)	Выполнить команду (2)	Результат (3)
1.	Р—ГРД—Г в положение (4) «Г»	ВКЛ [F] [ПРГ]	00
2.	Ввести программу (5)		
3.		[F] [АВТ]	0
4.	0,0175	[x→П] [8]	1,75 −02
	60	[x→П] [a]	60
5.	$S_{i,\,i+1}$	[x→П] [1]	$S_{i,\,i+1}$, км
	R_i	[x→П] [2]	R_i, км
	R_{i+1}	[x→П] [3]	R_{i+1}, км
	ОПУ_{i+2}	[x→П] [5]	ОПУ_{i+2}, град
	V	[x→П] [0]	V, км/ч
	ОПУ_{i+1}	[x→П] [4] [В↑]	ОПУ_{i+1}, град
	ОПУ_i	[−] [x→П] [7]	УР_i, град
6.		[В/О] [С/П]	УР_{i+1}, град
		[С/П]	ЛУР, км
		[С/П]	$S_{\text{эт}}$, км
		[С/П]	$t_{\text{эт}}$, мин
7.	Для вычислений по другому варианту перейти к п. 5. (6)		

Key: 1. Enter number; 2. Execute command; 3. Result; 4. To position. 5. Load program; 6. For computations using other variation, go to No 5

Program 2.

00 2	01 ÷	02 F tg	03 П→x2	04 ×
05 П→x1	06 ↔	07 —	08 x→П6	09 П→x5
10 П→x4	11 —	12 С/П	13 2	14 ÷
15 F tg	16 П→x3	17 ×	18 С/П	19 —
20 П→x2	21 П→x7	22 ×	23 П→x8	24 ×
25 +	26 С/П	27 П→x0	28 П→xa	29÷
30 ÷	31 С/П			

Example 2.

$S = 80$ км, $R_1 = R_2 = 9$ км, $ОПУ_3 = 332°$, $V = 800$ км/ч, $ОПУ_2 = 255°$, $ОПУ_1 = 296°$, $i = 1$.

Calculation results:

$УР_2 = 77°$, $ЛУР = 7,1589232$ км, $S_{эт} = 69,748539$ км, $t_{эт} = 5,2311405$ мин.

Time for calculations and recording results, 25 seconds.

3. Calculation of length of legs and flying time on legs when executing turn without considering linear angle of turn (above vertical of TIM of preceding leg).

Leg length is calculated with the formula:

$$S_{эт} = 0,0175RУР + \sqrt{(S_{i+1,\ i+2} - R\sin\alpha)^2 + (R\cos\alpha)^2 - R^2},$$

where $S_{i+1,\ i+2}$ -- is the distance between the TIM bounding the leg; alpha is the angle enclosed between perpendiculars to the line of the preceding leg at the point of turn (TIM $_{i+1}$) and to a line joining this point to the following route salient point (TIM $_{i+2}$); R, УР -- aircraft turn radius and angle.

Program 3.

00 П→x1	01 П→x2	02 +	03 П→x3	04 П→x4
05 ×	06 ÷	07 x→Пa	08 П→x5	09 ×
10 Fx^2	11 П→x4	12 П→x5	13 П→xa	14 $F\cos^{-1}$
15 F sin	16 ×	17 —	18 Fx^2	19 +
20 П→x5	21 Fx^2	22 —	23 $F\sqrt{}$	24 П→x5
25 П→x7	26 ×	27 +	28 П→x6	29 ×
30 С/П	31 П→x0	32 6	33 0	34 ÷
35 ÷	36 С/П			

Instructions to Program 3.

№ пп	Набрать число (1)	Выполнить команду (2)	Результат (3)
1.	Р—ГРД—Г в положение (4) «Р»	ВКЛ [F] [ПРГ]	00
2.	Ввести программу (5)		
3.		[F] [АВТ]	0
4.	6368	[x→П] [6]	6368
5.	B_{i+1}	[B↑]	B_{i+1}, рад
	B_i	[—]	$B_{i+1} - B_i$, рад
	B_{i+2}	[B↑]	B_{i+2}, рад
	B_{i+1}	[—] [×] [x→П] [1]	$(B_{i+1} - B_i) \times (B_{i+2} - B_{i+1})$, рад
6.	L_{i+1}	[B↑]	L_{i+1}, рад
	L_i	[—]	$L_{i+1} - L_i$, рад
	L_{i+2}	[B↑]	L_{i+2}, рад
	L_{i+1}	[—] [×] [x→П] [2]	$(L_{i+1} - L_i) \times (L_{i+2} - L_{i+1})$, рад
7.	$S_{i,i+1}$	[x→П] [3]	$S_{i,i+1}$, рад
	$S_{i+1,i+2}$	[x→П] [4]	$S_{i+1,i+2}$, рад
	R	[x→П] [5]	R, рад
	УР	[x→П] [7]	УР, рад
	V	[x→П] [0]	V, км/ч
8.		[В/О] [С/П]	$S_{эт}$, км
		[С/П]	$t_{эт}$, мин
9.	Для вычислений по другому варианту перейти к п. 5. (6)		

Key: 1. Enter number; 2. Execute command; 3. Result; 4. To position. 5. Load program; 6. For computations using other variation, go to No 5

Example 3.

$B_1 = 46°00'$ (0,803 рад), $L_1 = 135°00'$ (2,356 рад),
$B_2 = 45°00'$ (0,785 рад), $L_2 = 136°00'$ (2,373 рад),
$B_3 = 46°00'$ (0,803 рад), $L_3 = 136°00'$ (2,373 рад),

$S_{1,2} = 137$ км (0,02 рад), $S_{2,3} = 112$ км (0,018 рад), $R = 12,5$ км (0,002 рад), УР = 157° (2,74 рад), $V = 900$ км/ч, $i = 1$.

Calculation Results:

$S_{эт} = 143,82777$ км. $t_{эт} = 9,588518$ мин.

Time for calculations and recording results, 25-30 seconds.

Note: The EPU (IPU) and OPU of legs which include curvilinear segments following turn on the vertical of the terminal TIM of

the preceding leg (legs following the target) differ from the course angles calculated with Program 1 (we shall designate them $ПУ_{лур}$) by angle $\Delta\alpha$, which takes turn radius into account, that is, $ПУ' = ПУ_{лур} \pm \Delta\alpha$ (plus with a turn to the right and minus with a turn to the left). $\Delta\alpha = УР - \alpha$. Angle α is determined from the value of its cosine in Program 3 with commands $П \rightarrow xa$, $F\cos^{-1}$.

Adjusting Afterburning Turbofan Engines for Reliable Engine Start

90UM0621H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 16-17

[Article, published under the heading "Mastering Modern Aircraft," by Lt Cols A. Khvostov and S. Khodatskiy, candidates of technical sciences, and Maj V. Maslov, air regiment aircraft maintenance unit chief: "Reliability of Engine Start"; part one of two-part article]

[Text] **The excellent performance characteristics of modern gas-turbine engines have been achieved in large measure due to a certain compromise between improvement in their design, construction and layout, employment of new automatic-control devices, and a certain increase in difficulty in maintaining desirable operational and maintenance characteristics: reliability of engine start, ease of servicing and maintenance. In connection with this it is becoming increasingly essential that personnel of operating and maintaining subunits understand the physical substance of the processes which take place in an aircraft powerplant and the reasons for change in the properties and characteristics of engine start. This is particularly important since existing recommendations are fragmentary, scattered among numerous manuals and guides, and are frequently unavailable, for various reasons, to those who directly work with the engines. This article presents a synthesized discussion of the specific features and peculiarities of startup and operation of afterburning two-shaft turbofan engines (TRDDF), determined in the course of operation and maintenance, with the aim of assisting engineer-technician and flight personnel in engine operation and maintenance. * * ***

The next fighter taxied into position. Sr Lt V. Strelnikov confidently began his ground roll. The runway slabs were passing swiftly; it was time to rotate. But what was this? The engine was not reaching full power, and precious seconds were passing. The decision to abort came late—there was not enough runway left to brake the aircraft to a halt; there was no recourse but to eject.... The incident ended safely for the pilot, but the aircraft did not come out of it so well: it rolled off the end of the runway and smashed up.

What had happened? Why is it that the engine, which was on the whole in good working order, failed to reach takeoff power? The answer proved to be quite "simple." Just prior to flight operations the maintenance people had been performing procedures to ensure proper engine takeoff performance. Aviation Engineering Service specialists were adjusting the automatic acceleration control which, as we know, is involved in metering fuel during the final phase of engine start—just before throttling back to idle. After completing the adjustment (in violation of the requirements of guideline documents), they failed to check out the engine in other operating configurations. The airmen had been done in by "negative habit transfer": on the old engine the automatic acceleration control does not operate during engine start, while on the TRDDF it operates both during engine start and during high power output.

As new engines enter service, of new design and layout, characterized by a high level of thermal and gas-dynamic parameters, such difficult situations facing engineer-technician and flight personnel of practically all Air Force components are occurring with increasing frequency. There are also considerable problems with TRDDF engine start. Operating experience and theoretical studies indicate that ease of startup depends to a considerable degree on ambient air temperature and pressure, as well as on how hot engine components happen to be. For this reason aircraft combat capabilities sometimes prove to be limited in conditions of abrupt temperature drops and in conditions of high-elevation mountain terrain due to the impossibility of accomplishing engine start.

Worsening of engine start properties is manifested through change in compressor gas-dynamic stability factor (Delta-K_{yk}), gas temperature (T^*_g), and engine start time (t_{st}). The principal indicators used to evaluate reliability of engine start include duration of engine start cycle, which is determined by the time required by an engine to spool up to the specified rpm, and maximum gas temperatures, which characterize the compressor minimum gas-dynamic stability factor under conditions of engine start. The rate of turbine rpm increase as the engine spools up characterizes duration of engine start, while the magnitude of gas temperature jump characterizes the degree of allowable heating of engine components and decrease in compressor gas-dynamic stability factor. Rate of change and level of these parameters, considered together, determine the engine start process as regards duration and reliability.

In order to determine the causes of more difficult engine start under extreme operating conditions and in order to

study the physical processes taking place in individual engine components, calculations were performed on a computer, utilizing a mathematical model of the engine start properties of an F100 afterburning two-shaft turbofan engine, the compressor control system of which includes automatic engine start automatic control and automatic acceleration control used during engine start, while the starter consists of a compressor starter-power unit with free turbine.

Before proceeding to direct analysis of TRDDF operation, we shall briefly recapitulate the engine start procedure. First of all we shall note that this is a process of complex, difficult-to-calculate engine starting system operation conditions.

It can arbitrarily be divided into two phases: startup of starter system proper (5-10 seconds for a compressor starter and power unit), and engine start from the moment the compressor rotor commences spinning the turbine until the engine is throttled to idle (35-50 seconds).

Time interval figures are given for standard or near-standard atmospheric conditions. Across a broader range of atmospheric parameters, as a rule the duration of these phases increases with a simultaneous worsening of engine gas-dynamic parameters (gas temperature rises, compressor gas-dynamic stability factor drops). In these conditions a reliable engine start is not ensured without special procedures.

The second phase of engine start is considered determining both as regards duration and reliability. Limitations pertaining to conditions of component strength, gas-dynamic stability, and duration of process in the combustion burner are most probable precisely in this phase. We therefore shall focus principal attention on this phase in our analysis of TRDDF engine start properties.

In Figure 1, which illustrates change in relative acceleration of compressor rotor

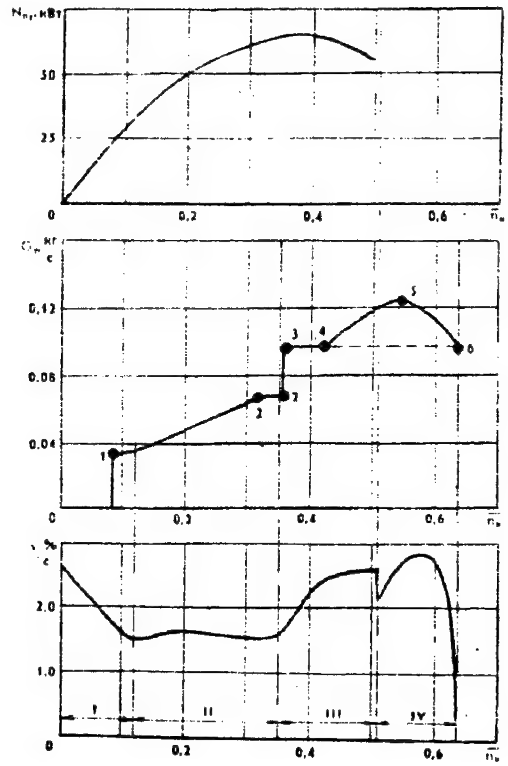
$$(\overline{n}^*_K = n^*_K / n_{K\,max})$$

in rpm

$$(\overline{n}_K = n_K / n_{K\,max})$$

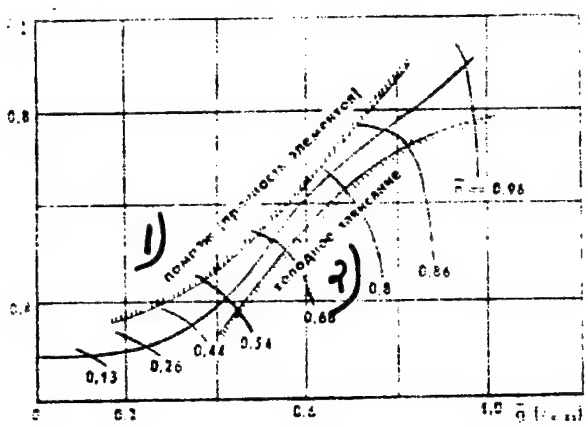
during engine start, one can specify four characteristic stages in the secondperiod or phase in conformity with the program of power delivery from the starter (N_s) and the program of fuel feed into the combustion burner (G_f): I—spooling up of TRDDF compressor rotor by starter until commencement of fuel feed into main combustion chamber by engine start automatic controller and fuel ignition; II—spooling up of TRDDF compressor rotor by engine turbine and starter during engine start automatic control operation phase; III—acceleration of TRDDF compressor rotor by engine turbine and starter during automatic acceleration control operation phase; IV—acceleration of TRDDF compressor rotor by engine turbine when the centrifugal governor cuts in, with engine throttling to idle.

Figure 1. Change in TRDDF Compressor Rotor Acceleration in Engine Start Mode in Conformity With Adopted Program of Fuel Consumption and Power Delivery From Starter.



One of the principal and conflictive problems pertaining to shortening the duration and increasing reliability of engine start in all powerplant operating conditions is that of maintaining extreme startup process conditions pertaining to gas-dynamic stability factors and gas temperature. The complexity of solving this problem lies in the fact that increasing gas temperatures in order to shorten engine start is limited by the strength of engine components or gas-dynamic stability factor. Duration of the engine start cycle increases with a decrease in gas temperature below the maximum allowable, and "cold" hangup of turbine spooling can occur. Thus one observes in the engine start process a narrow range of passage for the acceleration line between "surge" (strength of components) and "cold" hangup. Figure 2 contains a TRDDF compressor characteristic curve with acceleration line through the entire engine start range of change in rpm and the limit zones, upon entry into which engine start is not assured.

Figure 2. Limit Zones for TRDDF Rotor Acceleration Line in Engine Compressor Characteristic Curve Field.



Key:
1. Surge (strength of components).
2. Cold hangup

For this reason the engine start process depends to a large degree on the function of fuel feed into the main combustion chamber, which is determined taking into account the combustion chamber stable operation limits as regards rich and lean mixture and ensuring compressor gas-dynamic stability margin, heat resistance of engine hot section components, and required duration of engine start.

One of the peculiarities of fuel feed patterns on fourth-generation engines during engine start is utilization of maximum possible turbine output across the entire rpm range during engine start, from the moment of commencement of fuel feed into the combustion burner. Implementation of this fuel feed program is accomplished by a compressor control system, which in engine start mode constitutes a purely hydromechanical system.

The fuel feed program depicted in Figure 1 indicates that the engine start process on modern engines as well as those currently under development is determined not only by the parameters of the engine start automatic fuel feed control but also by the overall characteristics of the compressor control system. At the initial moment of fuel feed into the engine's main combustion chamber (point 1), fuel flow is determined by initial fuel pressure at the fuel nozzle, the value of which can be adjusted during operation. Further increase in rate of fuel flow is determined in conformity with adjustment of the engine start automatic control (segment 1-3). Fuel feed into the engine combustion burner ceases to be determined by the parameters of the engine start automatic control when it becomes greater than fuel flow determined by the characteristic curve of the automatic acceleration control. One should bear in mind, however, that in the regulator pumps there is a minimum fuel feed limiter ($G_{f\ min}$, which determines fuel flow in segment 3-4, and only after it becomes greater than $G_{f\ min}$ does the automatic acceleration control kick in (segment 4-5).

At TRDDF compressor speeds close to the specified idle rpm, a centrifugal rpm governor kicks in, which provides smooth change in fuel feed from G_f corresponding to point 5 to the fuel flow required for engine idle (point 6). Figure 1 also shows fuel flow in segment 2-2', which is dictated by the necessity of filling the second nozzle manifold in the TRDDF main combustion chamber.

By altering the parameters of the compressor control system, one can alter both duration of individual intervals and amount of fuel flow, corresponding to each stage of the second engine start phase. Since staying within limits during the engine start process is a condition of reliability of TRDDF start, with a change in operating conditions the TRDDF compressor control system should not constitute a source of occurrence of factors causing failure of the engine to start, that is, should not contain components the operation of which is climatically unsuited. Controls which change fuel feed into the main combustion chamber are used to accomplish this. The requisite change in fuel flow at the automatic starter operating stage can be achieved by selecting proper diameter of automatic starter metering jets. Increasing the diameter of the inlet metering jet (D_{ij}) or reducing that of the outlet metering jet leads to an increase in fuel flow, more effectively with greater air pressure downstream of the compressor, that is, adjustment to G_f increases with an increase in n_k. Effectiveness of adjustment also increases with a decrease in ambient air temperature. Naturally, all other conditions being equal, adjustment in fuel flow leads to change in exhaust gas temperature. Change in fuel flow only at the stage of automatic starter operation, however, exerts little effect on duration of engine start and is limited by the allowable exhaust gas temperature, dictated by the durability of engine hot section components.

Figure 3. Change in Fuel Flow With Various Metering Jet Diameters at Automatic Starter Unit Air Cavity Inlet.

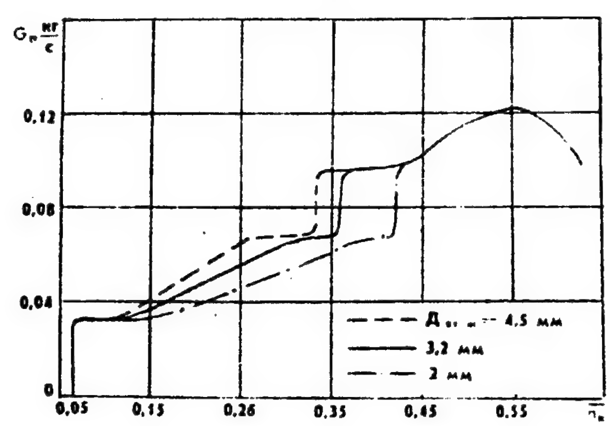


Figure 4. Change in Exhaust Gas Temperature and Compressor Gas-Dynamic Stability Margin With Various Adjustment of Automatic Acceleration Control for Fuel Flow.

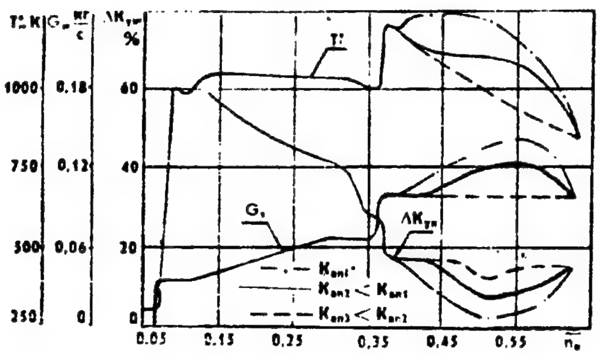


Figure 4 shows change in G_f, T^*_g and Delta-K_{yk} in relation to adjustment of the automatic acceleration control (determined by fuel flow adjustment factor—K_{ac}). This stage of engine start is determining both as regards duration and reliability. The starter is disengaged and rapid exhaust gas temperature rise and decrease in compressor gas-dynamic stability margin is observed during automatic acceleration control operation. A rise in exhaust gas temperature, which results in shortening duration of engine start, is limited by adjusting fuel flow at this stage of engine start by reducing Delta-K_{yk}.

When using the adjustment components of the engine start automatic control and automatic acceleration control to adjust the process of engine start in the course of operation and maintenance, one should bear in mind that changing the diameter of the air metering jets in these units leads to a change in the slope of the fuel flow characteristic curve (similar to Figure 3), while changing the setting of the adjusting screws of the automatic starter and automatic acceleration control leads to equidistant displacement of the characteristic curve (advancing the screws increases fuel flow, and vice versa). Such a difference in the nature of change in fuel flow by changing various adjustment devices determines the effectiveness of their utilization at a given stage of engine start. When adjusting fuel flow with an adjustment to the automatic acceleration control, however, it is essential subsequently to check the engine's operating condition during acceleration and at maximum power. The specific details of adjusting fuel flow for each type of engine are described in their maintenance manuals. **(To be concluded)**

Updating Flight Information For Military Aircrews on International Airways

90UM0621I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 18-19

[Article, published under the heading "Flight Safety: Experience, Analysis, Problems," by Col A. Yudenko, deputy department chief, Unified Air Traffic Control System Interministerial Commission: "On International Routes"; part one of two-part article]

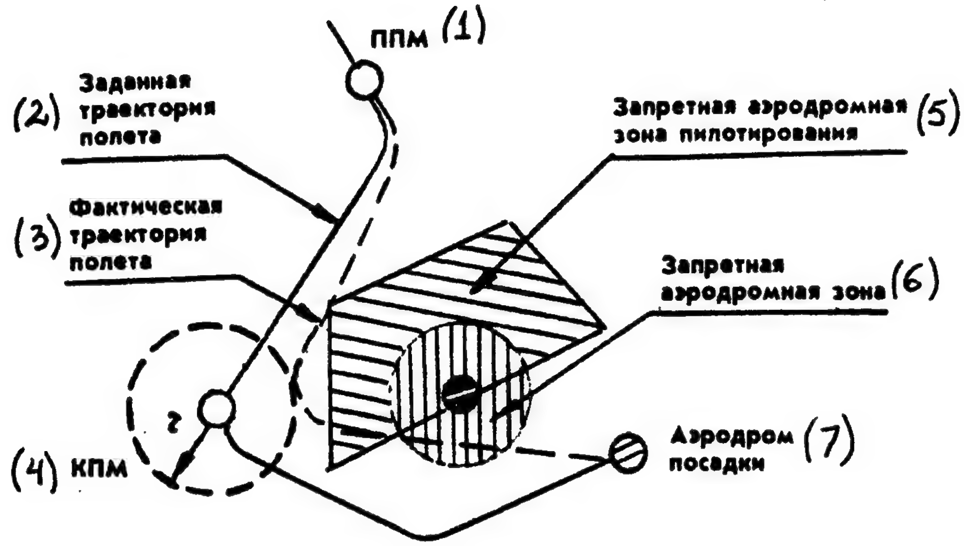
[Text] It is no secret that transport aircraft of the USSR Ministry of Defense also fly international airways (MVT), hauling various cargo. One such flight was made by the veteran crew of Capt V. Shalunov. The situation favored successful accomplishment of the mission. After passing the last enroute waypoint (PPM), the pilot in command was cleared by air traffic control (ATC) to proceed direct to the terminal navaid.

This final route segment was flown in instrument meteorological conditions. In addition, the terminal navaid facilities were not working well. Aircraft navigator Sr Lt S. Balikov, however, relying entirely on the terminal navaids, failed to make appropriate corrections in the airborne navigation system. As a result the aircraft wandered off the courseline and failed to make its turn over the final navigation fix, turning rather from a point off course and short. After this turn, without ATC clearance, the pilot headed direct for the destination field and crossed through two restricted airspace areas (see diagram).

This constituted a violation of flight regulations. Who was to blame? What causal factors preceded the violation? Could the mistakes have been avoided? What must be done in order to ensure that it does not happen again?

These and other questions arose when I was investigating this incident. According to the approach plate the crew was using (Ministry of Civil Aviation Air Navigation Information Publication [containing en route charts, terminal area charts, and instrument approach procedures plates), an aircraft was permitted, with the permission of destination field air traffic control, to proceed by direct route to the field after passing over the terminal navigation facility, in case of unreliable operation of the terminal navaid. This direct route passes along the control zone boundary. Granting such permission was prohibited, however, by an update (warning notice added to the approach plate) to the air navigation information documents [NOTAMS and Flight Information Publications] published both by the Ministry of Civil Aviation Air Navigation Information Service and by agencies abroad.

The revision notice reached the unit with which Capt V. Shalunov serves after the crew's departure. Obviously



Key:
1. Waypoint
2. Intended flight path
3. Actual flight path
4. En route terminal navaid
5. Terminal control area
6. Airport control zone
7. Destination field

the crew could not learn of the warning prior to departure, and subsequently they fail to consider the possibility of an update NOTAM, which led to the violation.As we know, when preparing for a flight on regular airways, crews use primarily air navigation information charts, NOTAMS, and Flight Information Publications. Corrections and changes are sent to the air units from the air navigation information service of the large strategic formations to which they are organizationally subordinate. Notice of changes comes to the flight information services of the large strategic formations from the Main Staff of the Air Force and from the Ministry of Civil Aviation Air Navigation Information Service. According to the Regulations on Organization of Air Navigation Information in USSR Armed Forces Aviation, notices of corrections and changes received by air units are to be entered into the master sets of air navigation information documents by air navigation information group specialist personnel. Wherever such personnel are not locally stationed, these entries shall be made by designated unit air traffic control personnel. Corrections in and changes to airborne flight information and navigation documents shall be made by crewmembers (pilots, navigators, radio operators). Following verification of air navigation information documents or following entry of corrections and changes, a record to this effect shall be entered into the corresponding document annexes.

It would seem that the above-described system of providing air units with air navigation information documents would make it possible to eliminate deficiencies in this area. Experience in preparing transport aircraft crews for regular-airway flights with utilization of available air navigation information, however, refutes this assumption.

The main difficulty in improving flight information support is a lack of close interministerial communication and coordination in preparing and publishing documents and delivering them to air units. Their preparation and publication, as well as corrections and changes, are handled by the Main Staff of the Air Force and the Air Navigation Information Service of the Ministry of Civil Aviation. Flight planning, preparation, and navigation documents for flights on regular airways, for example, are issued by the Ministry of Civil Aviation Air Navigation Information Service, and by the Main Staff of the Air Force for off-airway flights. The Main Staff of the Air Force also publishes instrument charts, and the Ministry of Civil Aviation Air Navigation Information Service publishes Air Navigation Information Documents for International Flights by Foreign Airlines (USSR AIP publications).

Air units are provided with these documents through large strategic formation headquarters, which in turn

receive them from the Main Staff of the Air Force and from the Ministry of Civil Aviation Air Navigation Information Service. In some regiments foreign publications are also used to prepare crews for flights using international airways. Aircraft crews encounter a great many difficulties when preparing for international flights, the most important of which is failure to be provided the requisite air navigation documentation in a prompt and timely manner. According to the Civil Aviation Navigation Service regulations (NShS GA-86), when flying on international airways, an aircraft shall have on board (aircraft of all ministries are governed by uniform regulations on international flights), in addition to the list of mandatory documents, air navigation information publications covering international airways, preflight informational bulletin, and regulations pertaining to flights on a specific international air route.

Crews of transport aircraft of the Ministry of Defense, in contrast to crews of Ministry of Civil Aviation passenger aircraft, cannot be provided with these documents. Particularly if the flight is to originate at a military airfield or if the crew has been away from its base for an extended period of time and has been assigned a mission involving flight on an international air route. However, experience in utilizing military transport aircraft in earthquake disaster recovery efforts in Armenia attests to the fact that air transport crews may be assigned a mission wherever they may happen to be and on any airway or air route, including international.

Limited time to prepare an aircrew for a flight in a difficult situation, lack of requisite air navigation documentation to prepare for a flight on international airways, and difficulties in filing flight plans when departing from a military airfield also cause military aviators considerable problems. In this case the crew must either land at an intermediate airfield which offers international air navigation support and flight services, or it must obtain the requisite flight information over communications channels, which substantially increases flight preparation time and worsens quality of flight preparation. And is it possible to communicate by telephone or telegraph the landing approach procedures with all descriptions and peculiarities applying to primary and alternate destinations on an airway or air route?

Even if an entire set of air navigation documents is received by an air unit (including foreign publications), as a result of differences in scheduling of publication and dissemination of corrections and revisions, aircrews do not always receive revised information in a timely manner. For example, changes in the approach plate for the scheduled destination of Capt V. Shalunov's crew were received by his military unit 10 days after they became effective! This was the main reason for the crew's violation of procedures at the international airport in question. In addition, on landing at a field en route the crew failed to use the opportunity to study received corrections (NOTAM) [Notices to Airmen] to air navigation documents, although upon filing their flight plan they should have requested from the flight service people any NOTAMs pertaining to their route and destination fields (primary and alternates).

One way to improve air navigation and flight information support for transport aircraft crews making international flights is to record and monitor the arrival at air units of corrections and revisions to air navigation and flight information documents, for as a rule large strategic formation headquarters is informed in advance on international flight aircrews and flight schedules. Incidentally, the air navigation information service subordinate to the large strategic formation is also fully capable of ensuring that these flights are provided with proper flight information support. Knowing the departure date and anticipated time of receipt of corrections and revisions, steps can be taken to provide aircrews with reliable information.

We should note that the procedure of providing aircrews with air navigation and flight information is complicated even for flights on domestic airways, especially when landing at fields lacking a regular air navigation information service, where the functions of this service are performed by combined unit (unit) control tower personnel.

They are trained essentially by the method of gradually amassing experience in working with air navigation and flight information documents in the course of their daily activities. At best the senior navigation officer of the air unit (combined unit) or communications and electronic support services officer will brief these specialist personnel on flight information document procedures. These latter, who in their daily activities have little involvement with matters of air navigation and flight information support, are unable to acquire adequate skills and abilities in performing this job.

And yet experience indicates that flight personnel need special training in working with air navigation information documents. At the present time, however, such training is not prescribed in the training schedules of air subunits.

In my opinion it would make sense to handle publication and supply of requisite documents to military units by a single unified air navigation information service, joining together the air navigation information services of the Ministry of Defense, Ministry of Civil Aviation, and other agencies. Regular classes involving practical demonstration of the sequence of preparing documents should be provided for personnel directly involved in air navigation support activities, for the job of military unit air navigation information service personnel consists not only in incorporating received revisions and addenda into documents but also in preparing reports to the air navigation information services of large strategic formations on revisions and addenda to air navigation data applying to their fields, communications facilities and flight operations electronic support services, for forwarding to the Air Force Main Staff and for subsequent centralized publication. In short, quality preparation of

air navigation documents is made more difficult without providing these personnel with specialized training. This applies particularly to those military units which do not have T/O air navigation information service slots. **(To be concluded)**

Su-17 Fitter Fighter-Bomber Pilots Return From Afghanistan

90UM0621J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 28-30

[Article, published under the heading "Encounters at Airfields," by Galina Marchenko: "Military Pilots"; concluding part of two-part article; part one appeared in No 2, 1990]

[Text] For some reason a lot of people think that pilots are "rolling in dough," and all at the expense of the overall welfare of our people. A pilot who is a lieutenant receives half the pay of an urban transit bus driver, for example. There is no additional pay for aerobatic skills: apparently aerobatic flying is equated with amateur performing arts.

The pilot's entire family lives virtually on his pay, since it is difficult for his wife to find a job on the base, not only in her area of specialization but any job at all.

And the problems with kindergartens; and the desperate problems with obtaining housing! The families of many pilots live under awful conditions in so-called transient-billet quarters and therapeutic rest facilities, which look like they were built back during the time of "war communism." And exhausting problems with supplying military bases with consumer goods and food.

In short, when the pilot comes down to the ground out of the sky, he is coming down to earth not only in the literal meaning of the term but also in the symbolic meaning we usually place in this expression. Add to this the extremely complex and difficult problems pertaining to his job! And perhaps problem number one is the one discussed in that TV film about military aviation, entitled "Further, Higher, Faster...." [reference to the Olympic motto]. Our military pilots are flying 21st-century aircraft, but airfield services and communications are literally out of the 1950s. The same problems of computerization and automation. But all this represents the peacetime life of military pilots.... As we know, however, in recent years they have also experienced life in a combat environment: taking part in combat operations in the Republic of Afghanistan.

Our troops pulled out of Afghanistan on 15 February, but the topic of the Afghan war and its problems are of concern to everybody even today.

"The army is an image of society," said Frunze. And war always reveals the essence: the essence of society and the state, the organization, phenomenon, and essence of man. And this is perhaps the only reasonable contrast in war to its destruction and its nightmares, of course not to mention its political and strategic significance. Recently one has observed a strange tendency pertaining to the events in Afghanistan: to indict the military, the officers and enlisted men, to make a scapegoat out of them, to pass off effect as cause. This would seem to be not only a violation of the legal presumption of innocence but also an outright breach of human decency. This is one of the reasons I want to talk about the Afghan veteran pilots with whom I am acquainted....

In November 1988 "Zhukovin's outfit," as they say in the military, returned to its home field. This air regiment had spent the last year in the Afghan war. Every pilot had logged more than 300 combat missions, each held two decorations, while eight had been nominated for a third. They returned home flying their combat aircraft, Su-17 fighter-bombers, which had been dubbed with the nickname "strizh" [swift—bird of that name] down there.

"Can one really think about oneself at such a moment?" Sr Lt Misha Bodakov, who is only 25, said to me. "Can one really? You know, one is supposed to use the prescribed communications phraseology when talking on the radio. But that is in peacetime; in war people just can't hold to the standard phraseology. Down below you a Soviet truck convoy is taking fire, really getting raked from rebel positions, and you hear over the radio: "Little Swift.... Come on baby.... Give us a hand here.... Coordinates...." You can't imagine what it means to hear a Russian voice coming from down there.... And when they shot down Sergey Yurchuk, all of us shouted at him over the radio: "Serega! Jump, Serega!"

But let us return to the very beginning. In October 1987, on the eve of the regiment's departure for Afghanistan, I spent several memorable days with its officers. I was not simply meeting them; I wanted to remember each one well. Within a few days these people would be flying off to war.

The pilot lounge shack was located adjacent to the Su-17 flight line. Technicians and mechanics were constantly bustling around the aircraft. Pilots would climb into the cockpit, and the mechanics would close the canopy and slap the wing "for good luck." The Sukhoys would head out along the taxiway to the active. They would fly out to the air-to-ground range, bomb practice targets, and return about 20 minutes later. Some time later they would go out again. This went on for days on end....

I tried to get as much interview time with regimental commander Col Anatoliy Zhukovin as possible. During our conversations my first impression of him was increasingly confirmed: he was an intelligent, brave, and kind individual. He looked to be about 40 years of age. I knew that Colonel Zhukovin had been offered a promotion, but he had firmly turned it down, stating that he would not let his boys go off to Afghanistan without him. And during that entire year he taught them to fight.

According to the pilots, study of the lessons and experience of the war in Afghanistan, air operations in that country, and passing on of this experience, had not been done in the Air Force during all those years. For this reason at first the regiment worked on problems at exercises which, as was subsequently ascertained in combat, would scarcely be suitable or come in handy. Zhukovin was perfectly aware of the situation and began finding out for himself, officially and unofficially, how aircraft were operating in Afghanistan, what was important and what was necessary.... And he taught this to his pilots. And regimental senior navigation officer Lt Col Yuriy Beldiyev, a serious individual, composed and precise in his thoughts, like a mathematician, said: "There cannot be a weapon against which one cannot learn to defend oneself...."

Jumping somewhat ahead, I shall say that all the regiment's pilots came back alive. But at the time, that fall, I gazed at them with pain in my heart: which of them would be returning and which ones would not? But they conducted themselves in a normal manner during these last days on Soviet soil. Take Capt Gennadiy Krakhmalyuk, the best pilot in the regiment, a flight commander, somewhat swarthy and gypsy-like in appearance, sociable and cheerful. Then there was his wingman, Capt Shamil Islamov, calm and restrained in the Asian manner, focused entirely inward. Regimental intelligence officer Capt Yuriy Kukharuk, who looked like a scholarship college student.... Zhukovin and I talked about incidents where a pilot, in order to avoid crashing into residential buildings, had deliberately flown his airplane right into the ground.... Zhukovin suddenly said: "If you want, I will point out to you those of my boys who would do exactly the same," and then added: "I would put my life on it.... I have a slight doubt about some, but perhaps I am wrong...." Tears suddenly appeared in his eyes....

I wanted very much to have a look at these boys, but I was frightened by a superstitious feeling.... Later, in the pilot lounge, however, I did try to figure who of these pilots would choose to plow into the ground rather than into residential housing.... What awaited them in the war, in far-off Afghanistan?

I made particular friends with Capt Andrey Voytyuk, secretary of the regimental Komsomol organization. Andrey was 26 at the time. He was born in Dneprodzerzhinsk. His mother is an artist. Andrey also could draw quite well, and all his relatives were sure that he too would become an artist.

"It was upsetting to me that everybody had decided for me and, to spite them all, I decided I wanted a military career...."

He was unable to fly for reasons of health and, while working in the political section, got interested in parachute jumping. He had made more than 150 jumps to date.

"One must act in accordance with one's situation...," Andrey explained.

Judging by all indications, he really liked being in the military. Nobody had such a dashing manner, saluted so smartly, or marched past the regimental colors in such a dashing manner. He was also a genuine Komsomol leader. The regimental Komsomol organization was the best in the district. And Andrey deserved much of the credit for the fact that in that regiment there was no hazing of conscripts by those with more seniority. In addition, Andrey became deeply interested in history. He had enrolled as a correspondence student in the history faculty at Dnepropetrovsk University, and in one more year he would graduate.

Finally it was my last day with the regiment that fall. The weather had deteriorated; ragged, wind-driven low clouds roiled by. Flight operations continued. At the end of the day Major Kravtsov, who had also been in Zhukovin's office during my visits, decided as a going-away present to demonstrate to the departing pilots his aerobatic skills with their future combat aircraft and to demonstrate all its superior features one more time.

Wearing their blue flight suits and helmets, the pilots stood by the pilot lounge, below the control tower cab.... As they watched Kravtsov's aircraft, they had a serious, concentrated expression on their faces. The entire group had quite a striking, picturesque appearance....

The regiment's one-year tour of duty in Afghanistan commenced. Meager information was received back about "Zhukovin's outfit." I can imagine how long that year was for the pilots' families and loved ones and how they waited for news from them....

...Last summer at Kubinka I had an interesting conversation with a combat air controller, one of those officers who during battle coordinate aircraft strikes on ground targets. In Afghanistan they were called "beacons." They are sort of like Simonov's "artilleryman's son." His name was Capt Yuriy Garbuz. He returned home from Afghanistan two years ago. He told me how once bombs were exploding about a hundred meters from him.... He wanted to dig right into the ground, but he was on rocks! By some miracle he survived, just like that Lenka-artilleryman—"nothing in life can knock us out of the saddle...." The captain also recalled that battle into which he was dropped to direct air-to-ground strikes. The platoon, surrounded by mujahideen, was pinned next to some sheer cliffs, and the platoon leader had been gravely wounded. The soldiers, seeing Yuriy touch down, ran over toward him....

"They were like children...," said Yuriy. "In combat an officer is everything for the common soldier!"

He led the platoon out of encirclement and saved the men's lives.... He was twice awarded the Order of the Red Star, as well as an Afghan government decoration. In spite of his youth—he is only 25—one can still sense

in him that knowledge of life which, strange as it may seem, is found only in persons who are well acquainted with death....

But the year passed, and again the season advanced to late fall. The pilots of Zhukovin's regiment returned to their home field in November. Three days later I visited them. Although at the time there was plenty of information available on Afghanistan and the military events there, nevertheless it is incomparably more interesting to talk with actual people who were there in the war. I was astounded at the change in them: they were gaunt, suntanned, all wearing a moustache like a garde du corps officer. But the main thing was that the facial expression had changed in all of them, as if during their days at war their character and soul had became more manifested in the face. I did not even recognize Zhukovin immediately—that moustache, and a slightly different smile, as well as a perceptible no-nonsense determination and an unyielding quality. He had become a combat commander. But these qualities did not diminish his profound humanity. Great is the influence of the commander in military units! This humanity determines in large measure interpersonal relations within the regiment; they contain so much mutual trust, respect, and love—this was truly a regimental brotherhood....

Andrey Voytyuk had also changed. He was 27 years of age, but standing before me was a man who was strong in both spirit and body, a man who had reached maturity. And a level and content of maturity which, perhaps, he never would have reached without this war. A lot of good things were said about Andrey. Zhukovin had told me how he had brought order in the barracks and that there was no hazing going on among the soldiers servicing the airfield. They told me about Andrey's courage and selflessness. He was constantly flying aboard helicopters as member of an airborne downed-pilot combat search and rescue team. They would go on station in tactical areas of operations, in case a pilot was shot down and forced to eject. They would extract wounded from the battlefield and sometimes the dead as well.

Andrey also accompanied truck convoys hauling ammunition, aviation fuel, and food supplies. They would be on the road for several days, sometimes as long as two weeks, in the heat and dust, while death watched them from behind clumps of brush in "Indian country." Lying in wait for them, the mujahideen would suddenly open fire. Andrey showed a great many slides and photographs he had taken in Afghanistan, providing accompanying explanation and commentary. And I examined these bare rock mountains photographed from a helicopter, combat at the entrance to a gorge, dusty roads, native villages, mosques, Soviet airplanes and helicopters on the ground and in the air, our trucks, APCs, and pilots, pilots with whom I was acquainted, wearing mottled-pattern camouflage suits, against the background of an alien sky and landscape....

Every one of them returned safe and sound! And yet there were days when they flew as many as four combat sorties! And here they were! Capt Gennadiy Krakhmalyuk, unusually serious; next to him, both on the ground and in the sky, his wingman, Capt Shamil Islamov. And regimental intelligence officer Capt Yuriy Kukharuk, and regimental senior navigation officer Lt Col Yuriy Beldiyev, who had flown more than 350 combat missions in Afghanistan. It was he who had plotted out the courses for his aircraft over that unfamiliar mountainous land.... I talked with Sr Lt Andrey Timofeyev, a Siberian from Tyumen, and I was surprised how different he was from popular notions about Siberians. Andrey is a man of fine sensibilities, with grace in his movements, and his hands are slender and handsome like those of a violinist. And then that awful thought came to me again: he too could have been killed, crippled, tortured by the mujahideen. He could have been captured, could have been missing in action....

"You are apparently the only regiment that succeeded in returning from there without casualties!" I said to Zhukovin. "That is what it means to prepare well...."

"There was no air-to-air combat—that is the main thing!" replied Zhukovin. "In addition, the war in Afghanistan was a war of helicopters. They got the heaviest action.... They played the most selfless role! When Sergey Yurchuk ejected and landed on a flank of the Panjshir Valley, which was alive with mujahideen, a helicopter-borne search and recovery team rescued him.... Toward the end of our stay in Afghanistan, when the number of helicopters had decreased in connection with the troop withdrawal, pilots on combat missions realized that if a missile brought them down they could expect either death or capture; there was no hope of rescue.... Helicopters were no longer maintaining search-and-rescue alert status in areas of air-to-ground operations...."

They also discussed with me the "strange aspects" of that war, tragically bizarre incidents and senseless operations.... Such as the following, for example....

...An Afghan regiment was guarding an important installation, a reservoir. The Afghans asked us to haul in food supplies and ammunition. An enormous convoy, with both Soviet and Afghan drivers, headed out. The convoy was on the road for several days. It was taking fire from "Indian country," and a flight of fighter-bombers from Zhukovin's regiment continuously flew overhead cover, the flights relieving one another in turn. "Beacons"—combat air controllers, positioned at the head and tail of the convoy, directed air-to-ground strikes. Eight men were killed and more than 50 were wounded, many of whom were seriously wounded, en route to the reservoir. And when they arrived at the reservoir—the Afghan regiment was nowhere to be seen! It had either deserted en masse or had defected to the enemy. There was nobody at the reservoir....

"We used to call the Afghan scouts 'storytellers'," recalled Gennadiy Krakhmalyuk. "Many of them simply made up stories! Sometimes for a specific purpose, such

as in order to settle some kind of tribal accounts.... Once this old man comes in and reports that there was a ZGU—a mountain-version antiaircraft gun—camouflage-sited in a village....

"'Are there people in the village?' we asked.

"'No, no,' he replied. 'there are no people there.... Just women and children....'

"People keep assuring me," Gennadiy continued, "that I was carrying out my internationalist duty. I keep thinking to myself: in precisely what did this internationalist duty consist?...."

Maj Yevgeniy Zlobin, regimental propaganda officer, who had dropped in to say hello, read some poetry he had written:

One lesson, one more grim lesson. Politics is a serious game. I reread Lenin's behests, Behests which were forgotten yesterday....

"What comes to mind first with the word 'Afghanistan'?" I asked Capt Aleksandr Yurchenko from the airborne search and rescue team. His reply sounded unbelievable....

"Buckwheat porridge, with nothing added! I have eaten enough buckwheat porridge to last me the rest of my life. We had it for months on end...."

Everybody agreed with Captain Yurchenko. The meals in our military units in Afghanistan were really bad, and that includes the pilots.... Although, as we know, here at home an effort is made to devote particular attention to the pilots' diet, since their job is so strenuous.... But in Afghanistan the pilots were engaged in a constant wrangle with Voyentorg to get better meals. A demeaning, energy-sapping struggle, but without result. It was out of the question to purchase fruits or other foodstuffs from the locals; it might be poisoned by the mujahideen. It was also impossible to obtain any food items at the post exchange. For months on end they sold nothing but razor blades and undercollar-liner cloth. The fact is that some Voyentorg employees were engaged in illegal trading of foodstuffs for Japanese radios and other items. Even in war our post exchange system continued its most unsavory practices. This is clearly logical, since "the army is an image of society." If during peacetime people steal at kindergartens, nursery schools, orphanages, elementary and secondary schools, boarding schools, and hospitals, why not rob military pilots who go out on combat missions? And soldiers who march into battle. And soldiers who work on the airfield in the terrible heat.

Holding back his agitation, Shamil Islamov told about their farewell dinner in the mess hall at Shindand just prior to flying home. Ravenous, they ran into the mess hall—and practically choked from the smell of bleaching solution; everything had been drenched in bleach—the tables and the dishes. The pilots themselves proceeded to wash the dishes in the sink, but when borscht was brought they were unable to eat it, because it too was half soaked in bleaching solution. The mess hall manager, Galina Grigoryevna, had calmly been taking it all in. Shamil went up to her.

"Galina Grigoryevna," he said, "may you feed your husband like this...."

"Don't you concern yourself about my husband," Galina Grigoryevna smirked. "I shall feed him properly...."

It was filthy dirty in the officers' quarters. Sometimes the field rations contained pieces of brick instead of food items. Shortcomings in support services in the military went beyond their off-duty lives; a poor job was done with supplying the field with aircraft spare parts....

We are all familiar with the quartermaster's job in war from our childhood schoolbooks. There were always complaints about the quartermaster service. They profiteered, made money on the war. But those were Czarist quartermasters, who lacked social consciousness. But what about today? What about today's quartermasters, most of whom are Communists? Will future schoolchildren study their actions and deeds?

The pilots spoke with particular bitterness about something that insulted their human and officer dignity to an even greater extent. The complaints applied primarily to Major General of Aviation Romanyuk, who was quite notorious in Afghanistan. This general spoke to the pilots in the style of a famous Czarist noncommissioned officer, NCO Prishibeyev.... The general's monologues cannot be quoted; they contain so much foul language. About the only thing we can quote would be expressions like "bare-bellied pup," which he might use in addressing a pilot who had just returned from a combat mission.

My highly-decorated friends were also incensed at bureaucrats at the ministry who had the gall to downgrade order-level decorations to medals, and without any hesitation, in spite of attestation by the certification board and command authorities in Afghanistan and nomination precisely for award of an order-level decoration. Award of decorations would take from six to eight months to process, and yet, as we know, promptness of recognition is important. But the most hopeless situation was the men's complaints about bureaucracy in the military, both in a combat environment and in peace, complaints about the vast number of various documents sent out for various reasons, demanding immediate reply, constant visiting boards, commissions and teams of inspectors, both with and without reason, etc, etc. Even these courageous men are reduced to despair....

Just before leaving, I dropped in to see the regimental deputy commander for political affairs, Lt Col Vladimir Fedorovich Mamalyga. The pilots were once again gathered in his office. In the last year they had become so accustomed to being together that now it was difficult for them suddenly to go their separate ways. The door to the

office suddenly burst open, and Andrey appeared, announcing: "Guess who I have brought!"

In walked Sr Lt Misha Bodakov, in a mottled-pattern camouflage suit, the kind they had worn in Afghanistan. He stopped and waited for a reaction. At this point I must turn for assistance to Lev Nikolayevich Tolstoy in order to tell you about Misha Bodakov. Misha is Tolstoy's Petya Rostov.... But a Petya born in our time, who graduated from school in Roslavl, Smolensk Oblast, who later graduated from the Borisoglebsk flight school, and who saw a year of action in Afghanistan. He is 25, but in spite of the war he looks 21 or 22. And he has that captivating charm of youth, which is not only an external charm but particularly lies in his state of soul, in his perception of the world, and in the poetry which he puts into his feelings toward beauty, love, women, and his fellow man....

"My God!" I exclaimed. "Who let him go to war?"

"But he fought well...," Zhukovin replied.

"I had an outstanding element leader," Misha explained. "Maj Yuriy Ivanovich Shigin! Have you heard of him? No? Then you cannot imagine what kind of a person he is! A real man—character, courage, dignity. The most horrible bedlam can be going on all around. I look at him and become calm. As always, he is self-possessed, cultured, and acts with sure hand, as if nothing at all is going on. He showed me that a person must be above any situation, must not lose control of oneself.... And on combat missions he always looked after me.... He took care of me.... You've just got to meet him...."

"What does the profession of military pilot give a person?" I asked.

"This profession really develops one's feelings. They become strong and deep. Pilots are strongly-feeling individuals...."

"You have a nice way of putting things...."

"I had an excellent literature teacher.... Our entire class was really lucky to have this teacher."

After he left, Zhukovin said: "This is our dream of the ideal...."

...Once a military pilot entered the subway car in which I was riding, a lieutenant colonel, with a young face but gray hair, and five ribbon bars on his chest. Nobody paid any attention to this pilot—neither the young people nor the older individuals in the car.... They did not look at his young face and gray hair, at his five ribbon bars....

More Efficient, Effective Aircraft Maintenance Procedures Urged

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[Article, published under the heading "Aviation Engineering Service: Problems, Inquiry, Solutions," by Maj N. Prosvetov, regimental engineer for avionics: "Contradictions of the 'Eternal Theme'"]

[Text] As he was summarizing performance results, specifying the status of efforts at thrift and economy, the regimental commander noted the success achieved by the specialist personnel of the aircraft maintenance unit headed by Maj N. Zhuk, which on this occasion as well had proven to be far superior in practically all indices. Among the components making up the unit's fine performance he mentioned the men's high degree of process discipline and technical knowledgeability as well as their feeling of responsibility for the state of affairs in each area.

I can foresee the objections by skeptics: "hothouse" conditions in the regimental aircraft maintenance unit, a finely-honed working mechanism, and the greater difficulty of doing an economical job at the squadron level. But in our opinion everything depends on one's attitude toward the job, on one's ability correctly to place emphasis.

Of what do savings consist in maintenance subunits? Combining of work tasks is skillfully applied at this level, close track of accrued engine time is kept, and collection of replaced parts which contain valuable metals has been organized.

A praiseworthy job is being done by the team headed by Sr Lt G. Galitskiy. This officer has succeeded in substantially boosting his men's proficiency and their work-process discipline. He regularly conducts essential appraisal of possibilities, which in the final analysis has enabled his team to achieve appreciable success in economic performance.

Efficiency innovators also make a substantial contribution. Good results were obtained from adopting a cable device for performing loading and unloading operations, using the electric winch which closes the doors of the aircraft shelter, a device developed by a team of innovators led by officer V. Mayorov. Now they no longer need a truck-mounted crane: labor requirements are reduced, and there are savings in engine operation, gasoline, and truck tires. But the most important thing is that it now takes less time to ready aircraft.

Innovative search led us to the idea of developing a standard device for loading software into the navigation system. Sr Lt V. Romanov and Soviet Army civilian employee R. Yatsina helped implement this idea. This new innovation has made it possible not only to improve conditions of servicing procedures but also to decrease by a factor of 15 the time required to load the navigation

program. It is no longer necessary to use an auxiliary power unit vehicle and has made the job of technical personnel much easier.

Development was a long, hard process (resulting in award of a Soviet Economic Achievement Exhibit medal), but as far as we know, the Air Force has not yet placed a contract with industry to produce the device. The navigation program loading method remains unchanged.

Another innovation authored by officer V. Mayorov has also proven effective. He suggested installing aboard the aircraft a small panel which will provide capability, tailored to the conditions of the specific training sortie, to simulate employment of various weapons. Calculations indicate that this device will reduce labor outlays by a factor of 12. It is one thing to submit a proposal, however, and a quite different thing altogether to achieve practical embodiment of an idea. Subsequent events have confirmed this. As it turns out, it is no easy matter to break down ministerial barriers and the wall of indifference on the part of officials. Does this not constitute waste of the state's resources? One can imagine the savings to be achieved by utilizing this and other efficiency proposals on a mass scale!

It is very important to utilize available resources intelligently. For example, utilization of the MiG-29's flight recorder system to monitor an aircraft's actions and performance during a training sortie enables Aviation Engineering Service specialist personnel to make a more thorough analysis both of the performance of the target engagement subsystem and the pilot's performance in the air. This makes it possible to prevent signing off fighters with malfunctioning systems and thus to avoid running up wasted engine operation time and unwarranted consumption of fuel and lubricants. The flight data recording system also provides capability to determine errors in flying technique by flight personnel and to provide appropriate recommendations to higher authorities on purposeful efforts to correct these mistakes.

Unfortunately such equipment is not carried aboard every airplane, but is available at the rate of one unit for every four combat aircraft.

A substantial impediment is presented by a poor level of automation in processing and analysis of flight recorder tapes. These procedures continue to be performed manually. Unskilled labor and processing which involves visual comparison with sample graph configurations and tables take up considerable precious time, which could be utilized for more important things.

Here is another contradiction within the "eternal theme" of economy. As we know, a pilot can fully master tactical moves only if he is carrying practice missiles. For various reasons, this is not always possible.

Once again efficiency innovators have come to the rescue. They have developed and adopted guided missile simulator plugs. The cost of this device is hundreds of times less than a practice missile, but the effect is the same.

Unfortunately we are "stewing in our own juice" to date with this development as well. And we so much wanted the "higher-ups" to take notice of it.

Military innovators could unquestionably be making an even greater contribution if the way were really smoothed for their efforts. We are not advocating that efficiency innovators be given some kind of special benefits or privileges. But in addition to personal satisfaction from what has been accomplished and understanding of the usefulness of one's labor, it is obviously important to concern oneself with providing them with the needed integrated circuits and other components. Material reward and incentive would also be useful, since amateur efficiency innovators frequently purchase required supplies with their own money.

Work in the area of achieving savings is determined in large measure by the level of skill of the serviceman. This in turn is determined by the methodological abilities of his superior, the state of training facilities and, finally, on one's personal attitude toward this problem. Many conditions could be named, and not one of them is of secondary importance in this chain.

It is precisely for this reason that we devote serious attention to precise organization of the training process for aviation engineering service personnel and make efficient use of aircraft maintenance days, specific inspections and maintenance checks of systems and equipment for increasing the skills of our maintenance technicians and aircraft mechanics. Good opportunities are also opened up with an innovative approach to training during aircraft preflight inspection and servicing procedures. Scheduling training to be conducted in case flight operations are canceled or suspended is an item of particular concern.

Unfortunately the regiment as yet lacks specialized training procedures and methods guides. This gap is being compensated for in large measure only through the initiative and independence of training class instructors and additional training organizational efforts. Particular zeal is being shown by officers N. Zadorozhnyy, S. Sysyuk, A. Burzak, and A. Antonov. They innovatively approach the business of training their men, frequently turn to reference and specialized literature, and make use of the experience and know-how of other innovators.

In conditions of transition to a new qualitative state of the Armed Forces, we cannot ignore matters pertaining to efficiency, discipline, and a caring attitude toward weapons and military equipment. It is important to devote more attention to preventive effort and to conduct explanatory and educational work in a purposeful manner, directing it toward a responsible attitude toward one's job duties. Failure to accomplish the job cannot be tolerated here.

Take an incident involving Sr Lt R. Zlotnikov, for example. A screwdriver tip was left behind in an aircraft engine due to this maintenance technician's carelessness. This resulted in damage to costly equipment and taking the aircraft out of service. Dozens of maintenance personnel will be working on repairing this aircraft engine. The aircraft's "absence" will also affect squadron combat readiness.

I believe that this example offers a graphic indication of the result of indiscipline, irresponsibility, and lack of adequate supervision by one's superiors and self-monitoring on the part of executing personnel.

Nor is it ever inappropriate to remind the pilot that it is essential to maintain optimal operating conditions and configurations during flight. This will make it possible appreciably to reduce vibration and dynamic stress on aircraft structural components, which in turn helps increase reliability and service life of principal components and extends engine life.

Thrift and economy should become a kind of economic law, for any gap in one's knowledge, poor level of technical knowledgeability, and carelessness not only adversely affect combat training but also as a rule lead to excessive expenditure of resources and materials and to premature failure of expensive equipment.

Foreign Aviation Briefs

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[Aviation briefs: "Foreign Aviation Briefs"; based on materials in the foreign press]

[Text]

Fatal Accidents Involving Stealth Aircraft

The end of the 1980s was marked in the United States by intensive efforts on further development and deployment of advanced weapon systems, including military aircraft. In this connection the Americans are placing high hopes on the F-117A fighter, developed by the Lockheed Corporation using Stealth technology. This is one of the most highly-classified military development programs. Information pertaining to the manufacture, testing or combat employment of the Stealth fighter continues to be kept under heavy wraps of secrecy. Recently, however, more and more details on this project have been making their way into the press, including tragic events involving two F-117A aircraft.

The circumstances involved in both fatal accidents are similar in large measure. They occurred during night flight operations in VFR conditions. Both aircraft were checked off for flight operations and had been operating normally prior to this time. They were flown by veteran fighter pilots who had logged several thousand hours both in the air and on flight simulators. The pilots had flown less than 80 hours in the F-117A, however, and were flying training missions, as it turned out, which were risky for their level of proficiency.

The first accident took place on 11 July 1986. Major Ross Mular [Moular] departed from the test range in Nevada at 0113 hours Pacific Daylight Time, using the callsign Ariel 31. He initially headed in the direction of the town of Tonopah, and then turned to a southwesterly heading after climbing to an altitude of 20,000 feet. Since the mission was being flown according to Instrument Flight Rules (IFR) in controlled airspace (above 18,000 feet), Ariel 31 established radio communications contact with both the Oakland and Los Angeles air traffic control centers and received clearance to descend to 19,000 feet on a southerly heading.

Near the city of Bakersfield Moular turned to the southeast, requested clearance to descend to 17,000 feet, and cancelled his IFR flight plan at 0144 hours. Approximately one minute later the fighter flew into a mountainside at an elevation of 2,280 feet. The aircraft was destroyed and the pilot was killed.

The accident investigation indicated that the F-117A had hit the ground at high speed, with engines developing full power. There were no signs of a fire prior to the crash, and there were no indications that the pilot had attempted to eject.

Moular was certified as current both on the F-117A and the A-7 attack aircraft. He had logged a total of 53.5 hours on the F-117A fighter. He was considered an experienced fighter pilot, who had logged considerable time on the F-4, F-15, and F-5 fighters prior to transitioning to the A-7. He was a determined pilot, who had been developing a new pilot training concept.

The second accident occurred on 14 October 1987. This accident contained a number of similar elements, although on this occasion the training mission involved cross-country terrain-following flight. Major Michael S. Stewart departed from the same test range at 1953 hours Pacific Daylight Time on a single-aircraft night flight. He was flying VFR within the boundaries of the Nellis Bombing and Gunnery Range. The ATC radar operator at Nellis AFB noted that the F-117A had drifted left from its intended track just before disappearing from the radar screen at 2033 hours, having completed three fourths of its scheduled route.

The Stealth aircraft crashed on hilly desert terrain, forming a crater 6-7 feet deep. The aircraft's emergency attitude indicator showed that the aircraft had struck the ground at a 28-degree nose-up and a 55-degree right-wing-down attitude. The accident investigation failed to reveal signs of a fire or damage to the aircraft prior to impact. The pilot had also made no attempt to eject.

In this case as well the pilot was considered to be an excellent pilot, who prior to transitioning to the A-7 and F-117A had served with units flying the F-15, F-4, and

F-5. Stewart had logged 2,166 hours in fighters, including 76.7 hours in the F-117A.

In the opinion of the command element of the 4450th Tactical Air Group, to which the F-117A fighters were assigned, there exist two most probable causes of these accidents: pilot physical fatigue, and avionics malfunction or failure.

Due to "restrictions involving safety," F-117A flights took place during hours of darkness. Often two sorties would be flown on the same night with the same aircraft. The "early shift" would fly until midnight, and the "late shift" would fly in the early morning hours. These flights usually ended at about 0330 hours. This resulted in chronic pilot fatigue. This factor was of such concern to the unit command element that flight surgeons were instructed to monitor the condition of the pilots on a continuous basis. Although the information contained in open publications about the aircraft's various sensors and instrumentation has been subjected to censorship, nevertheless it is apparent that the F-117A aircraft is equipped with night-vision devices, possibly a forward-looking infrared system. Testing of this system's displays revealed that under certain conditions it can cause pilot disorientation.

Thus in spite of measures taken to prevent the possible leakage of classified information, efforts by the U.S. Defense Department to develop new-generation airborne weapon systems by further utilization of the potential of Stealth technology are becoming increasingly obvious.

Weapons Testing

The aircraft and armament scientific research establishment at Boskom-Daun [Boscomb Down] is considered to be the British center for evaluation and acceptance testing of all military aircraft, military aircraft weapons and equipment. In addition to 10 permanently-operating flying laboratories, this facility has put up to 20 aircraft into operation at the same time. The range of research activity extends from aircraft full-scale acceptance testing preceding entry into operational service to testing of new versions of aircraft or equipment already in service. The research institute also evaluates carriage, release or launch of conventional, nuclear and guided weapons for all three services, and also studies the potential effect of electromagnetic emissions on aircraft instruments and equipment.

As we know, the safety and performance characteristics of modern aircraft armament depend to an ever increasing degree on computer software. At the same time it is very difficult thoroughly to test on the ground the effectiveness and reliability of electronics. Aware of this fact, institute specialist personnel seek alternative methods of ensuring that equipment meets standards. All new aircraft, such as the Harrier GR.5, undergo exhaustive testing with various combinations of weaponry. As a rule, theoretical prediction and evaluation of hazardous situations which could lead to unintentional weapon release are followed by ground testing, and subsequently in-air testing as well, of weapons carriage, release, and jettison. Basic problems revealed in the tests are reported: weapon vibration, missile as a rule, and especially on helicopters; oscillation by bombs following release, or collision when released in two dense a cluster; missile flame or exhaust gases causing engine compressor stall or overheating of the tail section of the carrying aircraft; hanging up of chaff on speed brakes; wandering of aircraft cannon off zeroed aimpoint; unacceptable flight paths of released munitions dispensers, weapons, or fuel tanks.

Recent tests have included launches of the Sea Eagle missile from Sea Harrier and Buccaneer aircraft, of the Skyflash missile from the Tornado F.3 aircraft, as well as release of concrete-piercing bombs from the Tornado GR.1 aircraft.

Future testing will include decisions pertaining to using British-made weapons on the Harrier GR.5 aircraft, the AMRAAM missile on the MRS.2 Sea Harrier and F.3 Tornado, and the ALARM missile on the GR.4 Tornado aircraft—the future designation of an upgraded version of the GR.1. In coming years there will also be evaluation of weapons for the EH101 helicopter and the EFA aircraft, plus an overall evaluation of British antitank weapons as well as a NATO modular standoff air-to-ground weapon.

Military Plant Conversion to Civilian Goods Manufacture

90UM0621M Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 38-39

[Interview, published under the heading "Following a Policy of Perestroyka," with Col N. Perets, aviation equipment plant commanding officer, by AVIATSIYA I KOSMONAVTIKA volunteer correspondent Lt Col N. Poroskov: "Not Losing What Has Been Gained (An Aircraft Maintenance Depot in Conditions of Conversion)"]

[Text] **For some time now the term "conversion" has become a firm part of our consciousness and daily lives. People talk, write, and argue about it. This issue was debated in the USSR Supreme Soviet at the level of general concept and strategy.**

But how is the process of partial conversion of military industry over to the manufacture of consumer goods proceeding at a specific enterprise? Our volunteer correspondent began his interview with Col N. Perets, commanding officer of an aviation equipment plant, with this question.

* * *

[Perets] One can already see in the specific operations of our enterprise an orientation toward the manufacture of civilian goods. Even in the past we supplied Aeroflot

with equipment and instrumentation for inspection and testing of jet engines and jet engine components.

Today we have proceeded further. In conformity with the ratified plan, last year we produced an additional 260,000 rubles worth of civilian goods. This included 36 separate product items, including short-supply water faucets, freight pallets, passenger car hubcaps, construction clips and staples, and even barrels for pickling mushrooms and cabbage. Automotive rubber products alone total more than 40 items. This is a stable—continuing from one year to the next—product list.

[Poroskov] Nikolay Vasilyevich, why were precisely these product items selected? The fact is that one must know market demand and the conditions of the emerging market. In addition, the giants of industry could go into competition with you and bankrupt you.

[Perets] Well, as yet this does not present a threat, in view of our shortage of goods across the product spectrum. However, we of course did not pick our product items out of thin air. We proceeded primarily from our capabilities: production process, availability of materials, nature and volume of the waste products from our principal production. We determined our product list in coordination and in agreement with the oblast executive committee trade department.

Production is going well. We are selling builder's window framing [prolachennyy shtaketnik], for example, right off the truck. We get 300 rubles per cubic meter of wood. Our automotive rubber products are selling like hotcakes, as they say, even in spite of a substantially overstated price. Natural rubber is added to our aircraft rubber. This means long life, lower friction, and other useful properties.

We are building a storage facility for Agroprom. We are in the process of setting up a line for testing refrigeration equipment. As you can see, the conversion-product spectrum is fairly broad. In addition, this year we are planning to boost the volume of civilian goods sales to 400,000 rubles. Although there are some enterprises where this figure is higher. So it is apparent that this amount is no upper limit for us.

[Poroskov] How has the situation for your workers changed in the new conditions of economic management? Will those working for "defense" not find themselves in a less advantageous position than their comrades who manufacture civilian goods?

[Perets] We do not have any shop or production line where the nature of the work is unequivocally differentiated. We produce both. For this reason there are no sharp differences in wages. It is another matter that more labor-intensive jobs, requiring high skills, are more highly-paid.

Take machine tool operators, for example. Under the new conditions of economic management they have received additional benefits: free lunches, and two free stays each year at the plant's therapeutic rest facility. When going on vacation such a worker receives a salary amount in addition to base pay.

Average earnings have increased, and presently run 277 rubles. A high proficiency-rating lathe operator can earn 500-600 rubles a month. There is no "ceiling."

Labor turnover has been substantially reduced. Labor discipline has improved. Discipline violators and fanciers of alcohol—those who were living at the expense of their work team—have left. Morale is much better, healthier: people see not only their work but also its relationship to the end result.

Collectivist elements have also become stronger. The best work team receives 10 percent added to the "14th wage." But workers are docked 10 percent for violations of discipline and process procedures.

The profit we earn is used to form many funds, such as a social, cultural, and services fund. We have a recreation facility and a Pioneer camp at the seashore, a well-equipped outpatient clinic, dining room, etc. For this reason few of our workers are in a hurry to retire.

Since we sell our goods abroad, we earn hard currency. We have purchased some production equipment, but that is not enough. We would like greater autonomy in utilizing our hard-currency income.

[Poroskov] Leading economists have acknowledged the presence of inflationary processes in this country. To what extent are wage increases connected to this phenomenon?

[Perets] There is one criterion here: increase in labor productivity should run ahead of increase in wages. At our enterprise they are 10.8 and 6.7 percent respectively. Therefore economic accountability in conditions of conversion is operating on a healthy foundation.

Nevertheless we have not gotten away from financial and other problems. For example, we have set for ourselves the task of ensuring the following correspondence: not less than 1 ruble of product value per ruble of overall enterprise payroll fund. At the present time we are unable to achieve this balance. I shall explain why.

It is no secret that manufacture of consumer goods rests in large measure on the defense budget. In order to sell civilian goods at a profit, it is necessary to set prices from which the consumer will recoil, with the possible exception of the above-mentioned rubber products. Here we are competitive. This is also indicated by feedback established with the consumer.

In short there exists a tendency toward an increase in the cost of military goods—the civilian-goods shops must be "fed." The problem is aggravated by a lack of raw materials.

[Poroskov] What is this, once again a transfusion of resources? After all, conversion was conceived as a

strong assistance to the economy, in a serious manner and for an extended time into the future....

[Perets] It has helped—we have eliminated the shortage of certain types of light-industry and processing-industry goods. It is another matter altogether that not all problems here have been resolved. In my opinion the concept and strategy of conversion has not been precisely defined.

The flip side of enterprise autonomy is also acutely in evidence here—a rapid rise in prices. The root of the evil lies in the fact that the previously-established foundation has not been properly cemented, and the existing list of goods has not stabilized. The number of product items has decreased, for we have been placed in conditions whereby we must proceed from considerations of our own benefit.

A shift to direct relations sometimes places an enterprise in a hopeless situation in which it has no rights. One plant, for example, from which we obtain transducers, is failing to meet its obligations. While literally one out of every two engines supplied by another enterprise is delivered not in proper working condition, and it fails to respond to telegrams registering a complaint.

In the past we could apply pressure to subcontractor enterprises via the Air Force rear services, Gosplan and Gosarbitrazh. This is no longer possible, and the penalties applied are not effective here, since they do not appreciably affect an enterprise's budget. What we need are heavy fines, ten times larger, which would eat into the material incentive funds, social development funds, and payroll of the guilty parties. Until they are formally codified in law, one cannot help but prefer the state procurement order. It is more reliable.

[Poroskov] In short, conversion is not as simple as it seemed initially. It contains its own "shoals and rocks." It requires material outlays—on reorganizing production, retraining workers, etc....

[Perets] Yes, that is true. Overhead expenses have also appeared: an engineering design department, economic services, and transport costs. All this is reflected in the cost of a product item and in the final analysis affects price.

We have adopted a number of manufacturing processes which are new to us: casting, and machining on numerically-controlled machine tools. They are dictated by the serial-production nature of the new production operation.

[Poroskov] Serial production, emphasis on quantity.... Will this not result in a loss of quality and reliability—these basic features of military goods?

[Perets] I would say that there is such an apprehension. Not only fine traditions of careful workmanship formed and developed at defense enterprises over the course of decades. Worker dynasties were also forming. We, for example, have five Kondratyevs. Working alongside USSR State Prize recipient Boris Zakharovich Bukashkin is his son Aleksandr. They and many other of our workers are accustomed to doing a high-quality job at all times. And now we have emphasis on quantity.... I believe this is a weakness in the conversion equation. For example, you are not going to use X-ray inspection on an ordinary hot water heater. The workmanship habit becomes lost.

Therefore we must not forget about psychological perestroyka, about conversion in people's way of thinking. The task at hand demands a thoughtful, cautious step, not a cavalry charge. Otherwise there is a danger of rapidly losing everything that has been accumulated over the course of decades, of high-technology defense enterprises declining to the level of the average enterprise. Erosion of the intellectual potential of design bureaus is also a real threat.

[Poroskov] We have heard such apprehensions voiced before. What are they based on: devotion to former methods or skepticism about positive prospects for conversion?

[Perets] No. Primarily serious analysis, sober calculation. Today it is essential to calculate conversion measures years into the future in order not to repeat past mistakes. I remember well how eight years ago military enterprises, on instructions from above, got involved in agriculture, and frequently without suitable facilities and without knowledge of what they were doing. We too established a hog raising unit. A kilogram of meat cost us 9 rubles 60 kopecks. Of course we sold it at a lower price—once again at the expense of the defense industry.

It is important not to turn conversion into a campaign or drive, of which there have been many. Heads of defense enterprises—experienced, knowledgeable individuals—are thinking about this. As a rule they set up two production lines: for producing consumer goods and for primary production. Plus double and triple inspection. This makes it possible to maintain quality and to boost output.

In any case, however, our most important task is to produce reliable defense-industry goods. Nobody has repealed military combat readiness. It seems to me that we must bear this in mind with any conversion.

[Poroskov] We have also heard the following statement: conversion is that element by pulling on which we can rescue the entire economy. What is your opinion on this?

[Perets] It is a dangerous delusion.

[Poroskov] So what should be done today, not repudiating conversion but, I would say, in parallel with it?

[Perets] Perhaps my ideas are subject to debate, but I would say: freeze prices and wages in order to accomplish accumulation. Say to people: we shall accumulate, and then we shall obtain profit. I do not exclude the possibility of leasing out the civilian sector of military enterprises. An independent enterprise needs a genuine

master, who has both obligations and authority. Modern equipment is essential. One should also probably focus attention on rates and quotas.

In addition: people should become accustomed to autonomy not in words but should actually feel that they are the masters.

We collaborate with the Czechs. I have visited that country on several occasions and have seen how the people work. I am not saying that our people work worse. But our Czechoslovak colleagues know how to organize. There is nobody standing around idle. Everybody is busy. They keep track of everything. A worker will not put a handful of wood screws in his pocket but will buy them at the store. A trivial item? No, an entire ideology. We unfortunately frequently do more talking about instilling a feeling of independence, responsibility, and awareness. But at the moment we are doing little. The party organization should busy itself in this area as well. If we can educate people, we shall work well, and we shall therefore also live well. In my opinion there is no alternative.

Information on Applying to Air Force Schools

90UM0621N Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 40-41

[Article, published under the heading "At Air Force Higher Educational Institutions," by Lt Col V. Smirnov: "For Those Who Choose the Sky"]

[Text] Air Force schools include flight schools, navigator schools, engineering schools, and aviation technical schools. Flight schools train pilots for all air components: fighters, fighter bombers, ground-attack, army aviation, bombers, long-range bombers, military air transport, etc, while navigator schools train navigators and air traffic control officers. Engineering and aviation technical schools train engineers and technicians specializing in maintenance: airframe and powerplant, aircraft armament, aircraft equipment and avionics, meteorologists and aviation rear services specialists.

These schools accept warrant officers (with the exception of aviation technical schools) on active duty in the USSR Armed Forces, compulsory-service and extended-service military personnel, military construction personnel, civilian youth, military reservists who have completed their compulsory service obligation, graduates of Suvorov military schools, Nakhimov naval schools, special boarding schools offering thorough study of the Russian language and intensive military physical training; candidates must have a completed secondary education and must meet all aptitude screening requirements. As of 1989 civilian youth, compulsory-service military personnel and reservists who have fulfilled their active military service obligation have been accepted to enrollment at the Air Force Engineering Academy imeni Professor N. Ye. Zhukovskiy.

Enrollment age for Air Force schools is as follows: for warrant officers and extended-service military personnel—not older than 23 years of age, and under the condition that they have served not less than two years in appropriate job assignments; for compulsory-service military personnel, military construction personnel, and military reservists who have met their compulsory-service obligation—not older than 23 years of age; for civilian youths—from 17 to 21 years of age. Term of service and age are determined as of the year of enrollment.

Military personnel desiring to enroll in military educational institutions shall submit a request to their unit commander by 1 April. The request shall state: military rank, last name, first name, patronymic, billet, year and month of birth, level of education, and selected service school. The following shall be attached to the request: a copy of the certificate of secondary education, party or Komsomol character reference, three certified photographs (head bare, measuring 4.5 x 6 cm), personal biography, and efficiency report. Candidacies will be discussed at a general meeting of subunit personnel, at which a decision on whether the request will be forwarded along the chain of command is to be made by a show-of-hands vote.

The required applicant documents shall be sent to combined unit headquarters by 5 April, and lists of names of candidates shall be submitted by 10 April to large strategic formation headquarters. Aptitude screening cards and all materials prepared in the military unit shall be attached to them and, when required, classified-installation work clearances.

Compulsory-service military personnel from all USSR Armed Forces units stationed on the territory of the military district (group of forces), who are registered as candidates for service school enrollment, are sent from 1 June to 30-day training sessions. These training sessions end with a preliminary selection of candidates. Large strategic formation boards, with the participation of service school representatives, select candidates on the basis of the results of a second medical examination, a test of their proficiency in drill and physical training, a personal interview on general military regulations and other subjects covered in the entrance examinations, as well as a test of their knowledge of Russian (dictation). Those who pass are sent to the service schools for the final selection process.

Civilian youths shall submit an application to the rayon (city) military commissariat in their locality of residence by 1 May. The application shall contain the following: last name, first name, patronymic, year and month of birth, home address and selected school (any). The following shall be attached to the application: personal biography, character reference from place of employment or school, party or Komsomol character reference,

copy of certificate of secondary education (secondary-school students shall submit an official report of academic standing), three photographs (head bare, measuring 4.5 x 6 cm).

Military commissariat rayon draft boards shall by 15 May (or sooner, as applications are received) conduct a preliminary screening of candidates. Medical cards shall be prepared, according to the prescribed form, for those candidates worthy of enrollment and acknowledged medically fit for studies. Youths enrolling in pilot and navigator schools undergo a second medical examination at oblast (kray) military commissariats.

Rayon military commissariats submit all necessary candidate documents to oblast (kray) military commissariats which, after appropriate examination, shall send them on by 5 June directly to the schools. By 30 June service school commanding officers shall inform candidates on when to arrive. A candidate's identity card, military service card or draft registration certificate, certificate of completion of secondary school, and birth certificate shall be submitted in person to the board of admissions.

Service school entrance examinations shall cover the secondary-school curriculum. The following subjects are tested at higher schools: mathematics, physics, Russian language and literature (composition), history of the USSR (at a service academy, a foreign language in addition); at secondary schools: mathematics, Russian language and literature (composition). In addition, each applicant is given a physical fitness test (bar chinup, 100 meter dash, 3,000 meter cross country run, 100 meter swim).

The manner and procedure of evaluating level of general educational preparation is practically identical to that followed at higher and secondary civilian educational institutions. An applicant is entitled to appeal denial of acceptance following the established procedure. A decision to accept to enrollment is made by the examining board on the basis of results in all candidate selection categories.

Heroes of the Soviet Union and Heroes of Socialist Labor, graduates of Suvorov military schools and Nakhimov naval schools and of special boarding schools are accepted without testing knowledge in general subjects, assuming all other requirements are met. In addition to the above, persons who have graduated from secondary school with a gold (silver) medal or from secondary specialized schools or secondary vocational schools with honors are accepted to aviation technical schools without testing general knowledge. This category also applies to students enrolled at civilian higher educational institutions. But they may be enrolled only in the first year of study, if their specialization area is appropriate to the service school's specialization. Otherwise these candidates are accepted to enrollment following the general procedures. The chairman of the examining board makes the decision on whether to proceed with a personal interview or entrance examinations.

Persons who have graduated from secondary school with a gold (silver) medal or from a secondary specialized school or secondary vocational school with honors, and who meet all other requirements, shall be examined in one specialization subject. If they receive a mark of five they are exempted from further examination, while if they receive a mark of four or three they shall be examined in the remaining subjects.

Enrollment to Air Force schools is based on a competitive selection process. Consequently one must compete for the right to enroll. The psychological examination presents a distinctive obstacle in the path of the secondary-school graduate, especially when seeking to enroll in a flight or navigator school. Of course thorough knowledge of the subjects studied at secondary school is essential, but quite definite psychological qualities are also required in order successfully to master the flying professions. This data is studied by specialists in the course of aptitude screening in military units, at military commissariats, and directly at the service schools, in the process of screening by the examining board. Psychological examination of candidates is performed with the aid of psychological diagnostic questionnaire and analysis tests.

During the screening and selection process all candidates stay in dormitories or barracks and are provided free board according to compulsory-service military personnel dietary standards.

Term of study is four years at flight and navigator schools, five years at engineering schools (six years at the service academy), and three years at technical schools. While in school cadets receive pay and are provided with meals and clothing. They are given 30 days annual leave plus a two-week vacation.

Graduates are given the military rank of lieutenant and are issued a chest emblem and standard diploma, and are awarded one of the following MOS classifications: pilot-engineer; navigator-engineer; mechanical engineer; electrical/mechanical engineer; electrical engineer; radio engineer; mechanical engineering technician; electrical/mechanical engineering technician; electrical technician; radio technician.

Addresses of Flight Schools

Kacha Order of Lenin Red Banner Higher Military Aviation School for Pilots imeni A. F. Myasnikov—400010, Volgograd, 10.

Chernigov Higher Military Aviation School for Pilots imeni Lenin Komsomol—250003, Chernigov, 3.

Kharkov Order of the Red Star Higher Military Aviation School for Pilots imeni Twice Hero of the Soviet Union S. I. Gritsevets—310028, Kharkov, 28.

Yeysk Order of Lenin Higher Military Aviation School for Pilots imeni Twice Hero of the Soviet Union Pilot-Cosmonaut USSR V. M. Komarov—353660, Yeysk, 7, Krasnodar Kray.

Barnaul Higher Military Aviation School for Pilots imeni Chief Marshal of Aviation K. A. Vershinin—656018, Barnaul, 18.

Tambov Higher Military Aviation School for Pilots imeni M. M. Raskov—392004, Tambov, 4.

Orenburg Red Banner Higher Military Aviation School for Pilots imeni I. S. Polbin—460014, Orenburg, 14.

Balashov Higher Military Aviation School for Pilots imeni Chief Marshal of Aviation A. A. Novikov—412340, Balashov, 3, Saratov Oblast.

Syzran Higher Military Aviation School for Pilots imeni 60th Anniversary of the USSR—446007, Syzran, 7, Kuybyshev Oblast.

Ufa Higher Military Aviation School for Pilots—460016, Ufa, 16, Bashkir ASSR.

Voroshilovgrad Higher Military Aviation School for Navigators imeni Donbass Proletariat—348004, Voroshilovgrad, 4.

Chelyabinsk Red Banner Higher Military Aviation School for Navigators imeni 50th Anniversary of All-Union Komsomol—454015, Chelyabinsk, 15.

Addresses of Engineering Schools

Order of Lenin and the October Revolution Red Banner Air Force Engineering Academy imeni Professor N. Ye. Zhukovskiy—125167, Moscow, 167.

Voronezh Higher Military Aviation Engineering School—394064, Voronezh, 64.

Irkutsk Order of the Red Star Military Aviation Engineering School imeni 50th Anniversary of All-Union Komsomol—664036, Irkutsk, 36.

Kiev Higher Military Aviation Engineering School—252043, Kiev, 43.

Riga Higher Military Aviation Engineering School imeni Yakov Alksnis—226031, Riga, 31.

Tambov Order of Lenin Red Banner Higher Military Aviation Engineering School imeni F. E. Dzerzhisnkiy—392006, Tambov, 6.

Kharkov Red Banner Higher Military Aviation Engineering School—310048, Kharkov, 48.

Kharkov Higher Military Aviation Engineering School of Electronics imeni Komsomol UkSSR—310165, Kharkov, 165.

Addresses of Secondary Aviation Technical Schools

Achinsk Military Aviation Technical School imeni 60th anniversary of All-Union Komsomol—662100, Achinsk, 1, Krasnoyarsk Kray.

Vasilkov Military Aviation Technical School imeni 50th Anniversary of Ukrainian Komsomol—255130, Vasilkov, 3, Kiev Oblast.

Kaliningrad Military Aviation Technical School—236044, Keliningrad, 44, oblast.

Kirov Military Aviation Technical School—610041, Kirov, 41, oblast.

Lomonosov Military Aviation Technical School—188450, city of Lomonosov, community of Lebyazhye, Leningrad Oblast.

Perm Military Aviation Technical School imeni Lenin Komsomol—614049, Perm, 49.

Imaging the Surface of Mars and Phobos

90UM0621O Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 3, Mar 90 (signed to press 31 Jan 90) pp 44-45

[Article, published under the heading "The Space Program Serving Science," by Yu. Zaytsev, department head, USSR Academy of Sciences Institute of Space Research: "Mars and Phobos in the Lens"]

[Text] Obtaining a series of photographs of the Martian moon Phobos was one of the important results of the Phobos project.

The instrumentation developed to perform this experiment consisted of three TV cameras—two wide-angle and one narrow-angle—a spectrometer, control and video recording systems. A charge-coupled device or CCD matrix, consisting of a silicon crystal the surface of which contains hundreds of thousands of sensors, served as emission sensor in the TV cameras and spectrometer. These tiny sensors convert incident light into electrical signals in proportion to light intensity. The photographic plates which were always a "standard attachment" to terrestrial astronomical cameras recorded only seven out of every thousand photons, while a charge-coupled device registers 700 out of every thousand.

The wide-angle-lens TV cameras provided two-zone imaging with large coverage for studying the topographic, geologic, and morphologic structure of the Martian moon. The narrow-angle camera provided capability to solve navigational problems and to perform detail imaging of Phobos and Mars.

A mirror-cover was positioned in front of the TV cameras. The cover protected the lenses during flight, while the mirror was used for photometric calibration of the

TV cameras from internal emission sources. Naturally the cover was opened for imaging and navigation procedures.

The spectrometer measured average brightness in narrow spectral zones. Spectrometry strip width corresponded to the wide-angle TV camera's field of view, while length was determined by space vehicle velocity. For example, at a speed 2-5 m/s it comprised 20-50 percent of the field of view of the wide-angle TV camera.

The video recording system was used to record, store and feed TV and spectrometric information into a radio communications data channel. The need to use a video recording device was due to the impossibility of real-time transmission of large streams of TV data.

The official name of the entire imaging system was Fregat videospectrometric system. It was designed to perform two very different tasks: to collect navigation information required to fine-adjust the interplanetary probe's position relative to the Martian moon, and to obtain data on Phobos.

As a result of prompt navigation processing of images transmitted from Fobos-2, accuracy of predicting the position of the Martian moon was increased approximately 10-fold, which made it possible successfully to perform orbital adjustment procedures on the interplanetary probe and to bring it in to a distance of 200 km from Phobos.

The navigational measurements are of considerable interest to science. In particular, they enable us to detail the characteristics of tidal interaction between Phobos and Mars, the librational motion of Phobos, its mass and density, and provide some information for analysis of its internal structure.

In the course of the experiment approximately 40 images of Phobos were obtained from distances of 200 to 1,100 kilometers, covering more than 80 percent of its surface. Resolution of images taken at the closest distances is 40 meters. A comparison of images obtained from Fobos-2 with images taken by the U.S. Mariner 9 and Viking probes indicates that they supplement one another well both in coverage of the Martian moon's surface and in spectral zones and conditions of observation. For example, Fobos-2 obtained the most detailed images of the area to the west of Stickney Crater, which had been poorly mapped by previous missions. The new images make it possible substantially to refine and detail the shape of Phobos and the map of its surface. Images of Phobos in the near infrared were also obtained for the first time.

As an aggregate all the TV images taken at various observation angles and lighting conditions make it possible to analyze the angular relationship between the brightness of the Phobian surface and the microstructures which determine its parameters, such as the typical size of regolith particles. These data are essential in order to study the processes taking place during meteorite bombardment of the Phobian surface, as well as to estimate the mechanical and thermophysical properties of its constituent material.

Images of the Martian surface in the infrared band, where it emits not reflected solar radiation but its "own" heat radiation, are among the most interesting results of investigation of Mars proper, obtained with the aid of the Thermoscan [Termoskan] device. A portion of the solar radiation energy striking the Martian surface is absorbed and heats the planet's surface. The higher the surface temperature, the brighter the infrared radiation.

This traditional method of measuring the temperature of the planets of the Solar System was initially used with observations from Earth, and subsequently was used by space vehicles. It was also repeatedly utilized in investigating Mars, but a visible image of the planet with the aid of heat rays had never before been obtained. The sole exception is our Earth—its "thermal portraits" are regularly transmitted back by weather satellites.

The "heart" of the Termoskan instrument is a highly-sensitive infrared radiation sensor cooled by an on-board closed cryogenic unit, in which liquid nitrogen is used as heat transfer agent. Never before had such devices been placed aboard unmanned interplanetary probes, neither Soviet nor foreign.

From a circular orbit at a height of about 6,000 kilometers, Termoskan "inspected" a large part of the equatorial zone of the Martian surface, in a strip approximately 1,500 kilometers wide, with a resolution of about 2 km. The thermal images transmitted back to Earth show sharpness and high contrast. In this regard they are even superior to the best TV images of Mars. And since the temperature to which the surface is heated depends on its physical characteristics, in particular on the degree to which the ground is broken up, thermal images also provide data on the macroscopic features of the surface (topography) and on its microstructure.

Synchronously with infrared imaging, Termoskan recorded short-wave radiation reflected by the surface. Thus two brightness values were obtained simultaneously for each element—in the infrared and in the visible portion of the spectrum. This made it possible to synthesize a pseudocolor image of the surface.

Rocket Structural Component Computerized Diagnostic Testing

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[Article, published under the heading "The Space Program Serving the Economy," by V. Filin, deputy chief designer of the Energiya Space Shuttle Launch Vehicle

System, candidate of technical sciences, and S. Gordeyev, candidate of technical sciences: "Diagnostics of Mechanical Systems"]

[Text] All existing methods of technical diagnostics in our industry are designed to ensure a sufficiently high level of reliability of rocket hardware. Serious problems do exist in this area, however, important among which is the problem of equipment support. It is good when one can perform diagnostics in a laboratory environment, with a sufficient quantity of the requisite equipment. But what if it is necessary to conduct testing in field conditions, inside mechanisms, or at the junction of moving connections?

A great variety of various devices is used for comprehensive inspection and monitoring of the technical state of mechanical devices. When developing new structural elements and processes, it is essential to be provided with sufficiently effective test equipment. More than 1,500(!) types of diagnostic instruments are used in modern machine building industry, devices which are arbitrarily subdivided according to GOST 18353-79 into nine principal types: magnetic, electric, Eddy-current, radio-wave, thermal, optical, radiation, acoustic, and by means of penetrating substances. Expenditures on testing, in comparison with overall production cost, are as follows: 5 percent in shipbuilding, 10 percent in pipeline construction, 15 percent in the aircraft industry, and up to 20 percent in rocket engineering.

As we know, the Energiya-Buran space program required considerable material outlays, which placed particularly tough demands on the quality of technical diagnostics. But any efforts to increase accuracy of investigation can produce considerable savings. According to the statistics, the payback period for test equipment is 10 to 15 times shorter than that on additional process equipment required to ensure an acceptable level of reliability. In addition, as practical experience has shown, validated departure from existing stereotypes of thinking when planning testing procedures offers significant advantages.

A substantial reduction in the number of needed experiments and testing operations is achieved by replacing a set of separate testing devices with a set of standardized devices, due to systems analysis and statistical synthesis of diagnostic parameters. According to the authors' preliminary calculations, for example, employment of an aggregate of "nontraditional" diagnostic means in connection with the first launch of the Energiya booster made it possible to save more than 16 million rubles in comparison with expenditures which are essential when utilizing solely conventional test equipment.

Systems analysis of test parameters consists primarily in precise separation of specialized methods and narrowly-focused application of each, which constitutes an initial basis for subsequent statistical generalization. Since it is not possible to describe the entire aggregate of test devices within the limits of this article, we shall discuss one of its most important areas—technical diagnostics.

For a long time technical diagnostics was equated with flaw detection, while the technical state of components was characterized as a rule by the presence or absence of defects. And yet practical experience indicates that in many cases such "diagnosis" fails to meet elementary requirements of reliability prediction. The main difficulty lies in the fact that destructive failure of a number of heavily-stressed launch vehicle assemblies takes place spontaneously from an initially no-defect state. A decisive role here is played by high-stress operating conditions and aggressive action by the environment. In addition, in contrast to other branches of the machine building industry, failures of rocket components as a rule do not repeat at the same location. This is due to the fact that a once-failed component is subjected to further work, which increases its reliability and eliminates the possibility of a repeat failure. Thus not only the search for defects but also determination of the future condition and status of flaw-free parts constitutes a major task of prelaunch preparation of space hardware.

A standard method has been developed to accomplish this task, grounded on a well-known pattern and mechanism, consisting in the fact that any (even an insignificant) period of operation of components is accompanied by certain structural changes in ultrathin surface layers from three to five microns deep. The intensity and nature of change in structure are determined primarily by operating parameters and the properties (condition and status) of the material from which the component is made. Such structural changes accumulate in the process of operation, weaken the material, and lead to the development of failure sites.

The state and condition of the structure of surface layers constitutes a unique "calling card" of the investigated object, which indicates where and under what conditions a given component was operated, to what extent it is worn, and how much it can continue to operate until the onset of failure. A strong component has a "high-quality" surface layer. But if the surface layer has lost its qualities or has begun to break down, the component will not last long—destructive processes will proceed from the surface and penetrate deep into the material, which will cause three-dimensional weakening and failure under operational loads.

In the process of numerous investigations of space hardware components, the authors of this article determined that ultrathin surface layers of elastic materials are capable of accumulating information on all effects occurring in the course of operation, like trees, which record climatic changes in the annual growth rings.

Such information is embodied in certain correlations of microflaws in the crystalline (or molecular) structure, the nature of which is strictly individual for each type of material, conditions of operation, and zone of investigation. The thickness of the "informational layer" varies

from one material to another. We have determined that for metals it runs 3-5 microns, 4-8 microns for carbon-reinforced plastics, 18-25 microns for nonporous rubbers, and up to 30 microns for synthetic polymers such as polyurethane.

This opens up fantastic possibilities for researchers, who can at least in part decode the information encoded in the microstructure of thin surface layers. Until recently such experiments were not possible, due to a lack of the required equipment. The main difficulty consisted in isolating a common pattern of randomly-positioned structural components (vacancies, dislocations, microflaws, etc). We accomplished this task with the help of specialized software for real-time processing of an array of parameters entered into the computer.

Collecting diagnostic information is reminiscent of what a tape recorder does, converting an invisible recording on magnetic tape into distinguishable signals. The operating principle of these devices is not only externally similar but also similar in physical nature to reproduction of a tape recording. A small-diameter hard roller with a point contact area is used as sensitive element (indenter) to read information on the properties of a thin surface layer. During uniform fluctuation of this roller (with constant speed and load), frictional force varies in relation to the mechanical properties of the deformed surface layer at the point of contact at each moment of movement. Information, encoded in the surface layer in the form of specific structural features, causes characteristic changes in the indenter frictional force, the pattern of which is determined by computer program. The roller-indenter, rolling along a section 1-2 mm in length, reads information like a recording head sliding along a magnetic tape.

Variability of frictional force even under stabilized conditions of external interaction is a most important feature of rolling movement by a roller indenter, which explains the basic operating principle of this diagnostic device. At a constant rate of rolling and constant load, one observes a change in frictional force in an orderly random sequence. This property is valid for the rolling of bodies with point contact. Static theories of constancy of friction with invariable conditions of interaction are valid in all other cases (involving measurable contact areas). We shall demonstrate this with some very simple examples.

Let us picture the movement of a loaded wheelbarrow with a single rigid wheel. Obviously differing physical efforts are required to move the wheelbarrow when it is traveling on asphalt, cobblestones, or a sandy beach. In addition, during rolling, such as along cobblestones, vibrations are observed, the frequency of which is determined by the size and location of individual cobblestones. We have here implementation of a highly simple "wheel-wheelbarrow-man" diagnostic system, where the human operator "feels" the road (even under a layer of dust) from the characteristic jolts and the wheelbarrow's resistance. Using the wheelbarrow's wheel as an indenter makes it possible to determine blindly the quality and properties of the road surface.

Diagnostic units work in a similar fashion. The surface layers of actual materials are reminiscent in structure of a cobbled pavement, "paved" by microinhomogeneous fragments of structure, the properties of which are distributed in a random manner, such as we see in the photograph [photo not reproduced].

Various types of scanning devices can be used to ensure uniform indenter travel. As an example we have included a photograph of a compact laboratory device which hooks up to a desktop computer [photo not reproduced]. This is a general-purpose device, since it can operate as a microstructure decoder, as a programmable friction machine, as a computer profile recorder, as a hardness gauge, and as a device to measure elastic hysteresis.

In spite of their comparatively simple design and construction, devices of this type make it possible to calculate up to 10-12 state and condition parameters in the process of a one to two minute experiment. The calculation procedure is simple; it essentially consists of the following: instantaneous values of friction force recorded at small quantization intervals are written to diskette during roller-indenter scanning of the target surface. Resolution of measurement is adjusted by selecting specific quantization intervals. For example, if a 0.01 m/s quantization interval has been specified on a scanning track running 1 mm, at a scanning rate of 1 mm/s the resolution will be 0.001 mm. If under the same conditions the scanning rate is reduced to 0.1 mm/s, resolution will increase to 0.0001 mm. A similar result can be obtained by reducing the quantization interval to 0.001 m/s.

After writing to disk an array of discrete friction values obtained with the required accuracy, they are processed by probability theory mathematical methods. Mathematical expectation, dispersion, frequency and harmonic components, multi-pole moments, spectral and other process characteristics are computed, for example. At the final stage the computer estimates the correlation between measurement results and standard parameters, on the basis of which the state and condition parameters of the target item of interest are computed and printed out. Since the entire process has been computer-automated, a single experiment, from commencement of gathering the array of values to printout of final results, does not exceed 2-4 minutes.

In conclusion we should mention one more feature of employment of this diagnostic method. Until recently it was considered essential to examine the entire volume of the component on which diagnostics was being performed. Only if this condition was met did one obtain the necessary reliability of measurements. Examination was performed primarily by instrumentation, with limited use of mathematical methods. Computerized technical diagnostics makes it possible substantially to

reduce the volume of examination without detriment to accuracy of analysis. The devices examined in this article, for example, make it possible to estimate the state and condition of components from the results of individual measurements in microareas of surface. Thanks to utilization of computerized means of analysis and synthesis, it is no longer necessary to examine the entire component, regardless of size, weight, and construction.

Diagnostic examination using this process is remotely reminiscent of taking a sample or specimen in an individual area, as is done, for example, in environmental studies. As we know, in estimating the state and condition of bodies of water, an air mass or plowed field, it is not necessary to study the entire volume of material; it suffices to examine a small sample. With microstructural diagnostics this "sample" is a small area of surface of the component being tested, the results of examination of which are generalized by mathematical criteria of similarity to the entire volume of the component.

These and other methods of precision digital diagnostics make it possible to perform a great many important tasks in modern machine building: to perform prediction and expert analysis, to select optimal manufacturing processes and operating conditions, with which failure-free operation is possible with minimal safety factors and structural weight.

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